Soil Geographical Database for Eurasia & The Mediterranean:

Instructions Guide for Elaboration at scale 1:1,000,000 version 4.0

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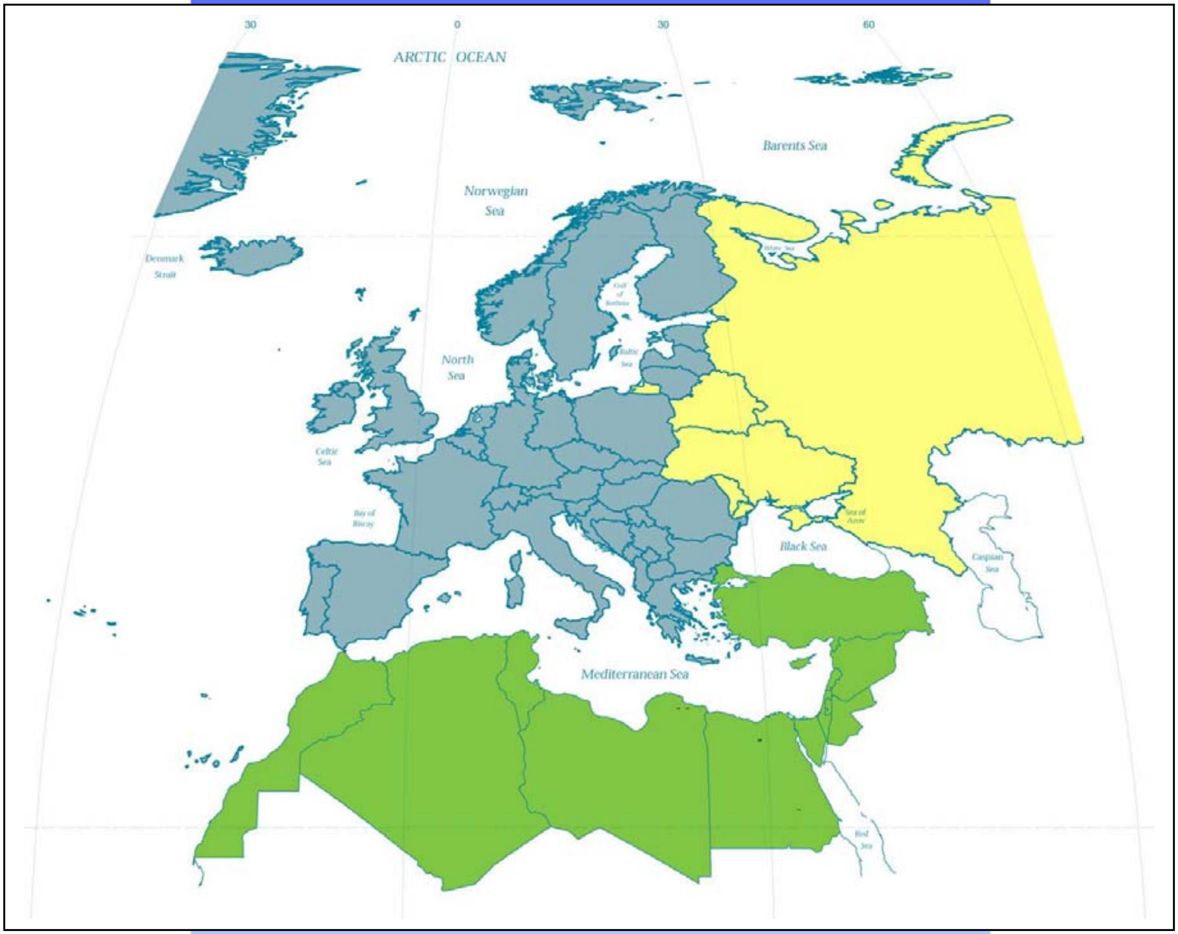

EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

INRA

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FOREWORD

For the elaboration of the previous versions of the Soil Geographical Database of Europe, instructions for contributors were given through a so-called "Users Guide". The progressive use of this guide during the past 10 years, and the geographical expansion of the database led us to update the Users Guide defining the rules for introducing the various data, including new attributes, into the database.

Because of a widespread demand, the European Soil Bureau decided to publish a new "Instructions Guide" for the expanded soil database. Primarily we wanted, through this new guide, to improve the methodology for data introduction, and thus we have tried to give a better basis for understanding the database content.

The present Instructions Guide describes the methodology that has been followed for the elaboration of the database, and is meant to facilitate as much as possible the task of the experts from new contributing countries in preparing and providing materials of the best possible quality.

In order to differentiate this new version of the Guide from previous ones, the title has been changed to ***"Soil Geographical Database for Eurasia and The Mediterranean: Instructions Guide*** **for elaboration** ***at scale 1:1,000,000".*** Therefore the current guide is the foundation for Version 4.0 of the Soil Geographical Database of Europe and will form the main component of Version 2.0 of the European Soil Database.

Following the decisions made in series of scientific meetings, and in order to conserve and strengthen the necessary coherence between the Soil Geographical Database at 1:1,000,000 and the more detailed database currently being compiled at scale 1:250,000, some attributes present in the initial guide have been modified. The organisation of the Guide has been changed to make it easier to read and to facilitate its use. A more explicit link has been made between the Geographical database, that stores the map information and the Soil Profile Analytical database (SPADE 1).

It contains what we hope are improvements over the previous version and it contains several new additions that affect both the form and content of the geographical database.

Concerning the *form*, the variables are listed in their order of appearance in the Soil Typological Units table. Each attribute is given a code, its meaning and its possible values are described in a small paragraph and a table.

Changes on the *contents* mainly consist in the use of a new "International Soil Classification" – The World Reference Base for Soil Resources (WRB) – and this will be the standard classification in use from now on. The FAO-UNESCO revised soil legend, previously used, will be kept as an attribute to maintain compatibility with some of the past thematic applications that are based on it.

A more detailed and completely revised Parent Material list, already in use in the 1:250,000 programme, has been introduced. This list comprises 4 levels: Major Class, Group, Type and Subtype. There are important differences between this and the former list of parent materials, with many adjustments necessary because a simple translation table was not sufficient.

Modifications to the *Profile Database* have also been introduced. Instructions to fill up the Profile attribute tables are now integrated in the Guide. The changes made to the Soil Typological Units attribute table, such as those concerning the soil classification and the parent materials, have correspondingly been made for the profile attribute tables. In order to maintain some compatibility of the "European" soil database with global programmes such as SOTER, the soil profile tables have been modified and some variables, such as soil colour and structure, have been added.

A first draft of this Instructions Guide has already received numerous improvements by users. Since future editions will be printed, we will be happy to receive any comments and suggestions for further improvements. However, the existing database is already fairly large and comprehensive in its coverage. Consequently, changes that could significantly affect its present structure and contents will be kept to a minimum.

The digital records in this geographical database, summarising our knowledge of the main soil types in Europe and neighbouring countries, will hopefully help to improve the management of soil resources and to promote their sustainable use in the future.

Marcel JAMAGNE
Chairman of the 1:1,000,000 Database Working Group of the European Soil Bureau

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COVER MAP
THE EXTENT OF THE SOIL GEOGRAPHICAL DATABASE OF EUROPE, VERSION 4.0:

CONTENTS

INTRODUCTION

In 1985, the Commission of the European Communities (EC) published a soil map of the EC at 1:1,000,000 scale (CEC, 1985). In 1986, this map was digitised (Platou, Nørr and Madsen, 1989) to build a soil database to be included in the CORINE project (Co-ordination of Information on the Environment). This database was called the Soil Geographical Database of the EC, version 1. Many applications of this digital EC soil database have been described by Van Lanen and Bregt (1988) and Jones and Biagi (1989).

In response to the needs of the MARS Project – Monitoring Agriculture by Remote Sensing (Vossen and Meyer-Roux, 1995) – of DG VI (Directorate General for Agriculture), the database was enriched in 1990-1991 from the archive documents of the original EC Soil Map and became version 2. The MARS project then formed the Soil and GIS Support Group of experts to give advice on the use of this database and to continue improving it. The Group recommended that new information should be provided by each of the Contributors. This resulted in the current version 3 of the database, covering the EU–15 and Candidate Countries. The basic principles underlying much of this work are described in King *et al.* (1994, 1995), Le Bas and Jamagne (1996) and Heineke *et al.* (1998).

Version 4 of the Soil Geographical Database at scale 1:1,000,000 provides a harmonised set of soil parameters covering Eurasia and Mediterranean countries for use in agrometeorological and environmental modelling at regional, national, and continental levels (Jamagne *et al.* 2002). In the immediate future, the database will be used for soil protection in general.

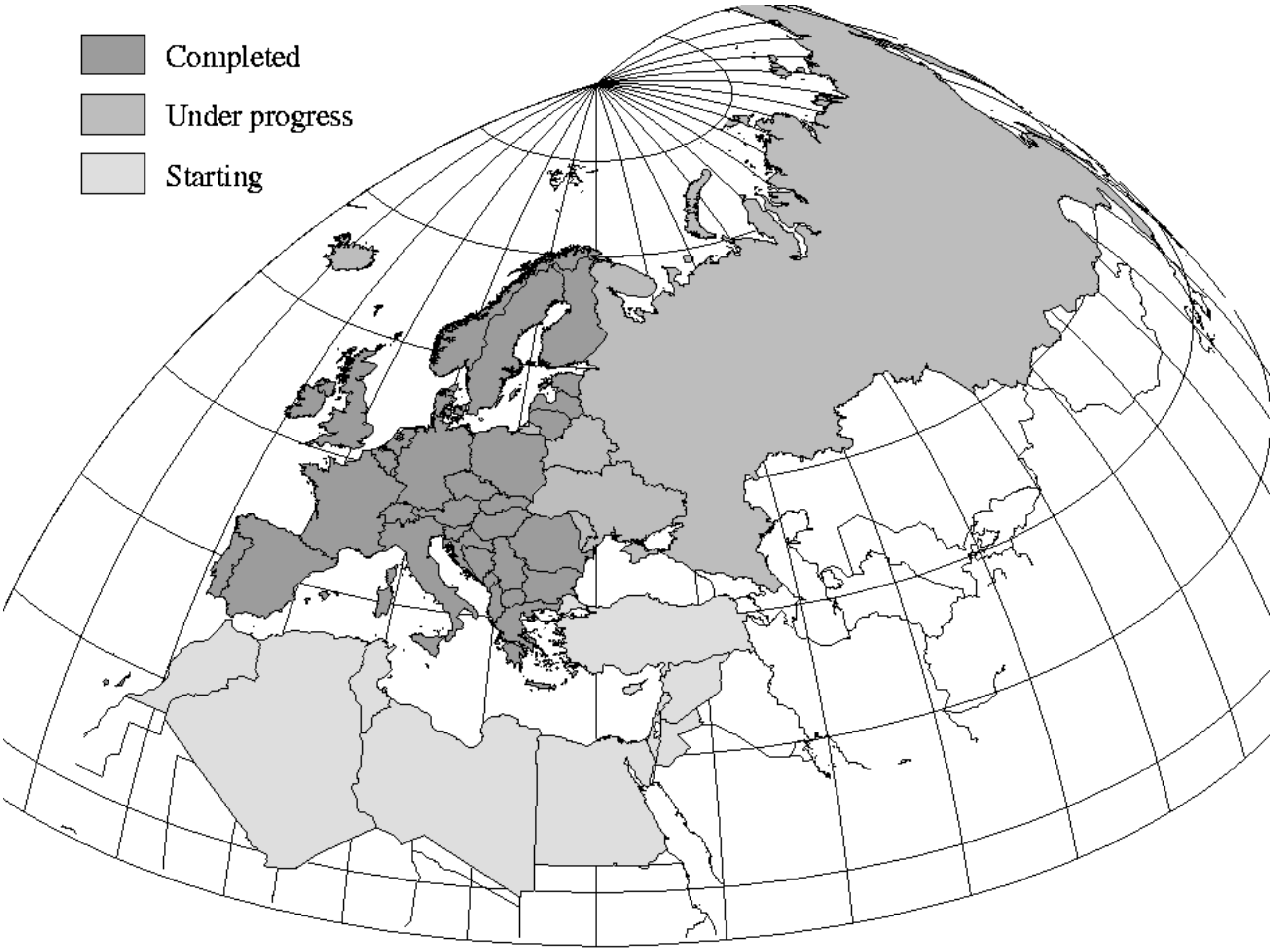

Figure 1: State of progress of the Soil Geographical Database.

The database currently covers Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, FYROM (Former Yugoslav Republic of Macedonia), Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom and Yugoslavia (see *Figure 1*). The extension to Eurasia covers the New Independent States (NIS) of Belarus, Moldova, Russia and Ukraine (Stolbovoi *et al.*, 2001). The expansion into the Mediterranean Basin will eventually include Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Libya, Malta, Morocco, Palestine, Syria, Tunisia and Turkey.

Beside these geographical extensions, the database has also experienced important changes during its lifetime. The latest major changes concern the introduction of a new extended list for parent materials prepared for the Soil Geographical Database of Europe at 1:250,000 scale (ESB, 1998). In addition, for coding soil types the new World Reference Base (WRB) for Soil Resources (FAO *et al.*, 1998) has been used in association with the FAO-UNESCO revised legend (FAO 1974, 1990), upon which the previous versions of the database have been based. All the work directed towards compiling a Soil Information System for Europe has been co-ordinated by the European Soil Bureau (Montanarella and Jones, 1999).

This Instructions Guide is divided into three parts covering the main components of the database:

- *PART 1* describes the geographical database and its structure.
- *PART 2* provides detailed instructions for the preparation of the geographical part of the database: paper or digital maps, Soil Mapping Units and Soil Typological Units descriptions.
- *PART 3* provides detailed instructions for the preparation of the soil profile data – both measured and estimated – and the linkage of these data to the soil geographical database.

The database is currently managed using the ArcInfo® Geographical Information System (GIS) software package. Therefore, the database description given here is based on concepts driven by this software, although we have tried to keep this association as flexible as possible.

The database under construction is called the *Soil Geographical Database of Eurasia and the Mediterranean at scale 1:1,000,000, version 4.0*. It will form the main component of version 2 of the European Soil Database that will be made available initially to contributing countries and in future to the wider public. We thank in advance all the Contributors for their efforts, past and future, to reach this goal. We realise that much work remains to be done to fully harmonise all the data, but we are confident that the development of this extended database will facilitate the exchange of ideas and concepts for future common programmes on soil management and protection.

PART 1: THE 1:1,000,000-SCALE SOIL DATABASE

1.1 THE DATABASE AND ITS STRUCTURE

The database contains a list of Soil Typological Units (STU), characterising distinct soil types that have been identified and described. The STUs are described by attributes (variables) specifying the nature and properties of soils (for example: texture, water regime, etc.). The scale selected for the geographical representation is the 1:1,000,000. At that scale, it is not technically feasible to delineate each STU. Therefore, STUs are grouped into Soil Mapping Units (SMU) to form soil associations. The criteria for soil grouping and SMU delineation must take into account the functioning of pedological systems within the landscape.

This section provides a conceptual and logical overview of the database as illustrated in *Figure 2*, and an overview of the corresponding ArcInfo® database structure, of terms used and underlying concepts. *Section 1.2* describes the materials that must be turned in by contributors. *Section 1.3* gives more detailed recommendations to contributors on how to complete their work and the transfer procedure.

Coverage: the SOIL coverage is the digital form of the soil map within an ArcInfo® database. It comprises a **geometric data set** to provide the shape and location of geographic features such as polygons, and a **semantic data set** to associate attributes (properties or variables) to those features. The semantic data set is made of attribute tables such as the soil polygon attribute table (SOIL.PAT), and other related tables such as the STU.ORG and STU tables.

Polygons: each mapped closed contour is called a polygon. Although it is not mandatory, polygon areas should be greater than 25 km^2. Each polygon must belong to one and only one SMU. An SMU can be composed of several polygons. Thus, each polygon is characterised in the soil polygon attribute table (SOIL.PAT) by one SMU identifier. Non-surveyed polygons (covering areas outside the geographical database boundaries or areas of non soil) are attributed a negative number as SMU identifier (see detailed description of attribute SMU in *section 2.3*). Each polygon must be labelled by an SMU identifier which is a number serving as a pointer to the SMU description in the STU.ORG table.

Soil Mapping Units (SMU): each SMU is identified by a unique integer-number (the SMU identifier). Each SMU must be represented on the map by at least one polygon. It is generally represented by several polygons. Each SMU must be composed of at least one Soil Typological Unit (STU). But, it is generally formed of several STUs forming a "soil association". In version 4.0, SMUs have no other properties than their STU composition, given by table STU.ORG. Any other SMU property such as its area, its number of polygons, its number of STUs, etc., are not useful at the stage of database construction and can be easily computed by the GIS software at a later stage. Therefore they do not need to be provided by the contributors.

Soil Typological Units (STU): a STU defines a soil type having a set of homogeneous properties over a certain area. So, the criteria for defining a STU is not only its soil name but the complete set of characteristics or properties as required in the STU table. For example, two STUs can differ only by their texture, or by their parent material. Each STU must lie within at least one SMU. A STU may be present in more than one SMU. This organisation is described in the STU.ORG table whereas STUs properties are described in the STU table. Each STU is identified by a unique integer number (the STU identifier) which serves as a pointer to corresponding records in the STU.ORG table.

Soil Typological Units Organisation (STU.ORG): the relationship between SMUs and their STUs components is described in the STU.ORG table. This information is stored by characterising each SMU with the list of STUs included in and the estimated percentage of area the STU covers in the SMU. The number of STUs within an SMU is not limited, but a maximum of 5 STUs is recommended. The sum of percentages attributed to all the STUs in a given SMU must be equal to 100 %. Each STU must correspond to at least 5 % of the total area of the SMU. Any STU under this threshold should be ignored.

Conclusion: therefore the database is composed of two data sets (see *Figure 2*):

1. the geometric data set, describing the polygons and indicating the SMU they belong to (SOIL.PAT table).
2. the semantic data set, describing the STUs properties (STU table) and the link between SMUs and STUs (STU.ORG table).

Relationship between the Soil Typological Units (STU) and the Soil Profile Database:

For each STU present in the Soil Geographical Database, there should be a corresponding estimated soil profile described in the Soil Profile Database (Madsen and Jones (1995). The estimated soil profile data may be based on several profiles described and analysed, or the data may be estimates carefully prepared by an expert familiar with that soil type. The estimated soil profile should represent the average typical profile that best characterises the STU.

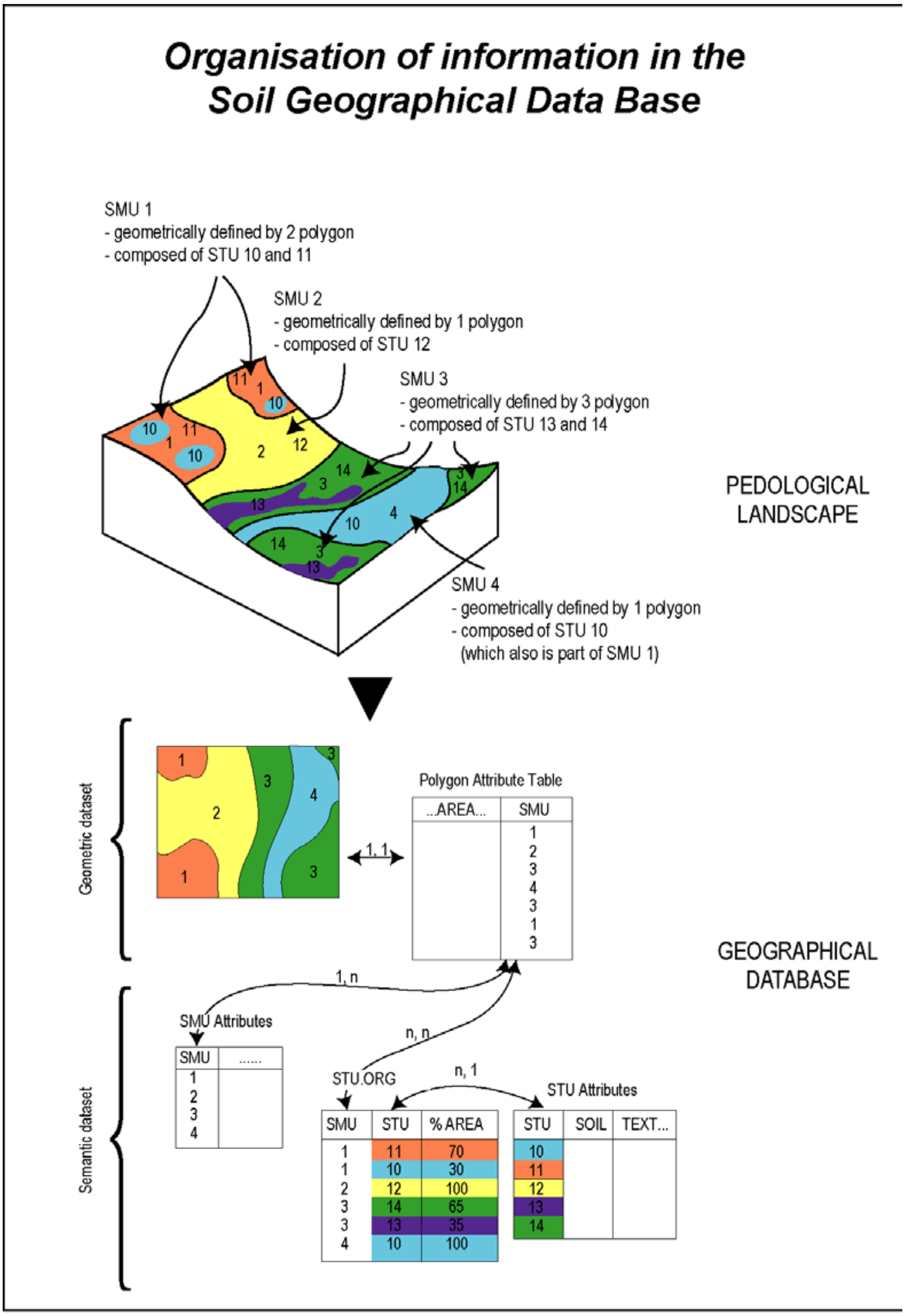

Figure 2: *Conceptual overview and organisation of the 1:1 M Soil Geographical Database.*

Each STU should also have one or more equivalent measured and georeferenced soil profiles. This measured and georeferenced soil profile should be located in a SMU where the specific STU is actually found as a component.

It is important to establish a reliable link between STUs and the Soil Profile Database. STU characterisation is very general and does not contain information about soil organic matter, colour, or even particle-size distribution of the fine earth fraction. Having a typical measured or estimated soil profile in the Soil Profile Database, linked to a specific STU will greatly facilitate the elaboration of models for a number of thematic applications such as soil erosion or organic carbon studies.

PART3 of the present Instructions Guide contains the set of instructions to prepare the Soil Profile Database.

1.2 GENERAL INSTRUCTIONS FOR CONTRIBUTORS

In addition to this Instructions Guide, Contributors will receive the following materials:

- A topographic map extracted from the Digital Chart of the World database (DCW). It shows the main political and topographical features: country border-lines, rivers, lakes, towns, and hypsometric contour lines (lines of iso-altitudes). These are meant to help to position correctly the soil map elements.

- Whenever relevant, a soil map extracted from the current version of the Soil Geographical Database. It shows the polygons and SMU numbers in neighbouring countries if they are already included in the database. It is intended to help harmonising the soil map along border-lines.

  Both maps are at scale 1:1,000,000, and cover a 50-km buffer zone around your country. Quad-neatlines are indicated in degrees of latitude and longitude. These maps are projected in the standard projection system used for the CORINE geographical databases which has the following parameters:

  Projection: LAMBERT_AZIMUTHAL
  Units: METRES
  Spheroid: SPHERE
  Parameters:
  - radius of the sphere of reference (metres): 6378388.0
  - longitude of centre of projection: 9° 0’ 0.0’’
  - latitude of centre of projection: 48° 0’ 0.0’’
  - false easting (metres): 0.0
  - false northing (metres): 0.0

- Whenever relevant, a listing of all available descriptive information for all SMUs present in the buffer zone on the extracted soil map mentioned above. It is meant to help to harmonise soil data along the country borders, and also to give examples of soil descriptions as they exist in the current database.

- A blank table with the same format as the one mentioned above. This form can be used to fill the SMU/STU descriptions for those who wish to work on paper at first. But final data sets should preferably be sent in digital format, if possible.

- A "DICTIONARY FOR REPORT COLUMN HEADERS" for the two above mentioned listings, in printed form.

- A blank table to be used to fill the soil profiles description for those who wish to work on paper at first. But final data sets should preferably be sent in digital format, if possible.

- An MS-DOS 1.44 Mb floppy disk with the seven following files:
  - SMU-STU.XLS: this is an empty Microsoft Excel® version 97 spreadsheet table. It is the digital version of the above mentioned one page blank table form. You can use this spreadsheet table if you have a spreadsheet software that can load Excel® 97 tables and choose to build your own SMU/STU descriptive information in digital form rather than in paper form.
  - DICTIONA.TXT: this a simple ASCII text file. It is the digital version of the above mentioned "DICTIONARY FOR REPORT COLUMN HEADERS" listing. It documents the previous Excel® 97 table.
  - SOIL.E00, STUORG.E00, and STU.E00: these files contain an empty ArcInfo® polygon coverage and all the related tables in ArcInfo® EXPORT format. If you have ArcInfo® or PC-ArcInfo® software and if you choose to fully build your own soil database directly in digital form, you can use these files as an empty template to start with. You should then IMPORT these files into an ArcInfo® database with the following commands available at the ArcInfo® prompt (Arc module):
    Arc: IMPORT COVER soil soil
    Arc: IMPORT INFO stuorg stu.org
    Arc: IMPORT INFO stu stu
  - MEASPROF.XLS and ESTIMPROF.XLS: these are empty Microsoft Excel® version 97 spreadsheet tables for respectively measured and estimated soil profile tables. You can use these spreadsheet tables if you have a spreadsheet software that can load Excel® 97 tables and choose to build your own Measured and Estimated soil profile descriptive information in digital form.

You should then have a database with a structure corresponding to the descriptions given in *section 1.1* and *Figure 2*. The template coverage is already defined in a geographic latitude/longitude co-ordinate system (no projection).

1.3 IMPORTANT RECOMMENDATIONS TO CONTRIBUTORS

Contributors have the choice of preparing the soil information for his/her country either on paper, or in digital form, or using a combination of both. In all cases, the information must include:

- Geometric data set (soil polygons and the SMU number to which they belong) in either the form of a printed map or in digital form;
- Semantic set (SMU/STU composition and full STU properties, measured and estimated soil profiles) either on printed forms or in digital table files.

1.3.1 Printed maps and documents required for the geometric data set

If you choose to provide paper map documents, please provide us with the following:

- A 1:1,000,000-scale map showing **only** soil polygons delineation and no other elements except georeferencing points (see below) (no annotations, and no SMU numbers should be printed on this first document). If possible, the document should be on a stable milard transparency support. The contours should be properly closed up, drawn with a thin solid black line of constant width. The document will be used for scanning and should therefore be as clean and unambiguous as possible to minimise further editing problems.

- The map should be accompanied by the following information for georeferencing:
    - Description of the document's projection system and parameters.
    - A minimum of four (4) (more is better), known georeferenced points. The points should be precisely drawn at their correct location on the map with a cross-hair symbol and labelled with a unique identification number.
    - An accompanying listing, on a separate sheet, of these points giving their identification number and their known X and Y co-ordinates given **in the previously defined projection system**.

This georeferencing information is necessary to achieve a proper geometric fit with the current Soil Database and requires careful attention.

- A hardcopy on ordinary paper of the above map, onto which the proper SMU number for each polygon is drawn in an unambiguous manner. See *section 2.3, on page 10,* for the SMU coding scheme. With the help of that document, we will attribute its corresponding SMU number to each scanned polygon.

1.3.2 Digital files required for the geometric data set

If you choose to provide a digital map, please send an ArcInfo® EXPORT format file of the soil coverage (ArcView® shapefiles are also acceptable, for any other digital format, please contact us). The coverage should have a "CLEANed" polygon topology. Each polygon should hold one and only one label point. The polygon attribute table (SOIL.PAT) should have the format described in *section 2.3, on page 10.* Each polygon should be labelled with the identifier of the SMU it belongs to.

The coverage should be georeferenced in any known and well-defined projection system (see ArcInfo®'s PROJECTDEFINE command). This is necessary to achieve proper geometric matching with the current Soil Database and requires careful attention.

The file named SOIL.E00 on the attached floppy disk (see *section 1.2 on page 5,* on provided materials), provides an empty template that you can use to start with. The file was EXPORTed from an ArcInfo® database and should first be re-IMPORTed into ArcInfo®. Beware that this template coverage is already defined in geographic latitude/longitude co-ordinate system (no projection).

1.3.3 Printed documents required for the semantic data set

If you choose to provide paper documents, please use as many copies as needed of the provided blank table forms to build your SMU and STU descriptive information, and your soil profiles descriptive information. To help you in this task, consult the attached "DICTIONARY FOR REPORT COLUMN HEADERS" listing and *PART 2* of this

Instructions Guide for SMUs and STUs description. Consult *PART 3* of this Instructions Guide for soil profiles description.

- Use *PART 2* to find out the correct coding scheme of all the attributes describing SMUs and STUs. The SMU and STU identifying numbers have no particular meaning except for non-surveyed areas or non soil areas which must be coded with a negative number (see coding scheme for attribute SMU). Other SMU numbers and all STU numbers are identifiers and must therefore be **unique keys** to identify those objects. They can simply be sequential numbers. The soil name code must be given using the World Reference Base for Soil Resources (attributes WRB-GRP, WRB-ADJ and WRB-SPE), with its correspondence in the FAO-UNESCO 1990 Revised Legend (attributes FAO90-MG, FAO90-UNI and FAO90-SUB).

- Use *PART 3* to find out the correct coding scheme of all the attributes describing Soil Profiles.

- Each attribute must hold only **one single value** (no list of values).

- **Expressing the lateral variability of some soil properties for STUs:**
  For some properties (e.g. soil surface texture), there can be a high variability within an STU. For such properties, the corresponding variable has been divided into two attributes (e.g. TEXT-SRF-DOM and TEXT-SRF-SEC). The first of the two attributes (e.g. TEXT-SRF-DOM) must be used to store the value of the property which is considered as **dominant** or **most important** over the STU. The second of the two attributes (e.g. TEXT-SRF-SEC) is used to record the variability within that STU by storing the value of the property which is considered as **secondary** or **less important**. If there is no variability, or variability is unknown, the value of the main attribute **must be copied** to the second attribute for that property.
  Examples:
  - TEXT-SRF-DOM = TEXT-SRF-SEC = 4 means either that the texture **is not** variable within the STU (texture is fine all over the STU), or that its variability **is unknown** (in which case, the variability is neglected).
  - whereas TEXT-SRF-DOM = 4 and TEXT-SRF-SEC = 1 means that there **is** a surface texture variability within the STU. Texture is dominantly fine, but in some parts, that STU has a coarse texture.
  - whereas TEXT-SRF-DOM = 4 and TEXT-SRF-SEC = 0 also means that the surface texture **may be** variable within the STU. Texture is dominantly fine, but that there is no information for the secondary surface texture.

1.3.4 Digital files required for the semantic data set

If you choose to provide a digital file for the semantic data set, record the SMU and STU attributes and the soil profiles attributes directly in digital form by using either the Excel® 97 or the ArcInfo® blank tables provided on the attached floppy disk. To use Excel® 97 tables, you need to have a spreadsheet software capable of loading Excel® 97 tables. To use the ArcInfo® tables, you need to have either ArcInfo® or PC-ArcInfo® or ArcView® software to IMPORT and edit the .E00 files.

To enter information on the attributes, please follow the same instructions as those for the paper documents (See *section 1.3.3*).

Please return the completed files in Excel® 97 format. Dbase® 4 or ArcInfo® formats are also acceptable. If properly **formatted and documented**, simple ASCII text files are also acceptable.

1.3.5 Transfer and delivery of materials

When your documents and/or digital files are ready, you can send them to the address given below. If you choose to send digital files, please send an EXPORTed ArcInfo® coverage or ArcView® shapefiles for the geometric data set, and either ArcInfo® EXPORTed tables or Excel® 97 or compatible tables for the semantic data set. ArcInfo® EXPORTed components should not be compressed at the time of EXPORT (use EXPORT with the NONE option). Please use either MS-DOS 1.2 Mb floppy disk, or Iomega ZIP 100 Mb disk, or recordable CD-R, as media for the transfer. If necessary, you can compress files using any PC compression utility as long as you also send the expansion utility and/or instructions along with your compressed data.

For any other digital formats or transfer media, please contact us to find an agreement (ArcInfo® has many possible file exchange formats, such as DXF-AutoCAD®, and it will certainly be possible to find one that matches your requirements).

Please send materials to:

Christine LE BAS
Post mail: **INFOSOL - INRA Orléans**
B.P. 20619
45166 OLIVET CEDEX - FRANCE
E-mail: **Christine.Le-Bas@orleans.inra.fr**

If you have any questions, do not hesitate to ask us at any of the following addresses:

Christine LE BAS, Marcel JAMAGNE, Micheline EIMBERCK,
Joël DAROUSSIN or Dominique KING
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1.3.6 Border harmonisation

After all the data from the contributing countries have been received, compiled, and included here into one single database, a second phase of harmonisation across country borders will probably be necessary. This requires INRA to prepare a map document with a 50 km-wide buffer zone covering both sides of the border between each pair of adjacent countries. This document will be accompanied by the semantic data associated with all SMUs found in the buffer zone. The co-ordinators from the countries involved must then propose their solutions to harmonise the polygons and data along their common border. This may require editing (adding, deleting, changing) any of the components of the database: polygons geometry, SMUs, STU/SMU components and proportions, STUs, and STU attribute values. If you wish to minimise this phase, we can facilitate contacts with the representatives of the neighbouring countries. This would help perform the harmonisation during the map and data compilation stage, rather than *a posteriori*.

PART 2: DETAILED GEOGRAPHICAL DATABASE DESCRIPTION

2.1 INTRODUCTION

This part of the Instructions Guide is devoted to an in-depth description of the components of the database, down to the description of the coding scheme for each attribute present in the database. But first, we present hereafter some definitions for the concepts manipulated through the present database structure, and general recommendations for the description of the corresponding objects.

It follows the logical schema of the database recalled in *Figure 3* below.

Each object in the database is described in the following sections from the most general to the most specific:

- coverage,
- attribute tables,
- attributes,
- attribute values.

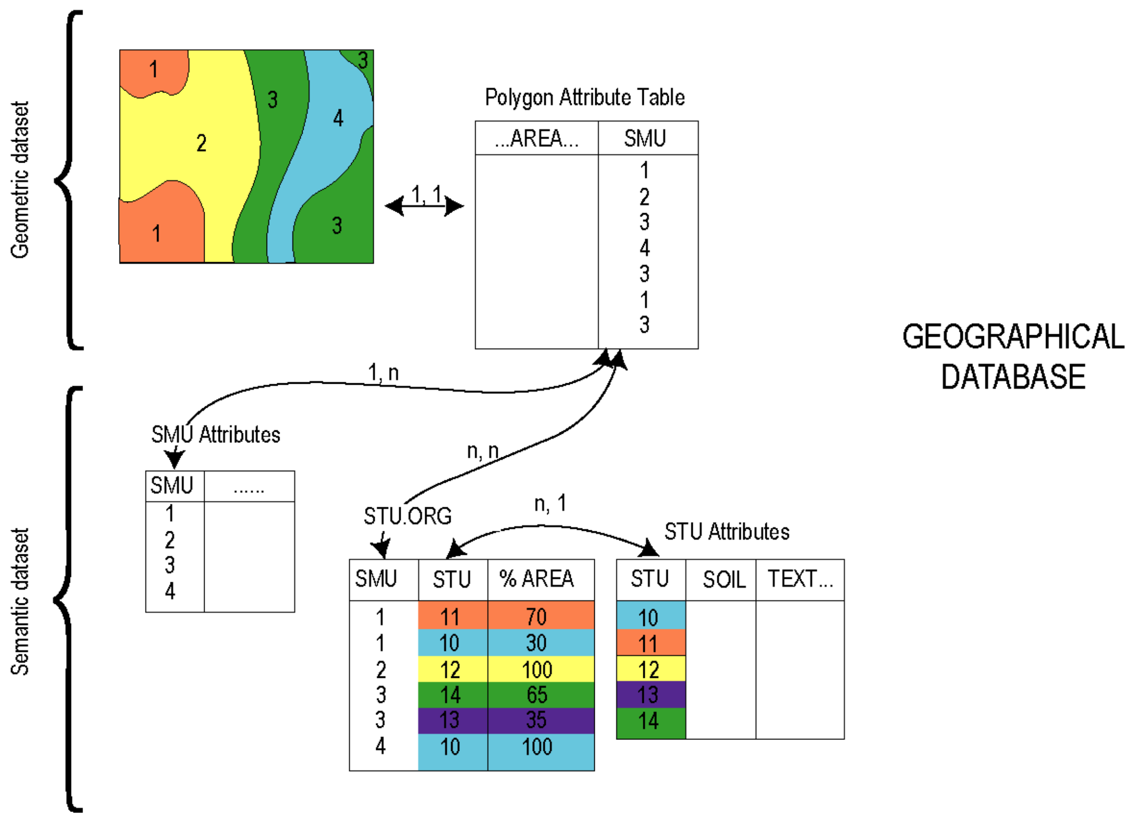

Figure 3: logical structure of the database.

2.2 ARCINFO® COVERAGE SOIL

- Coverage **SOIL** is the ArcInfo® digital form of the soil map. It holds the delineation of all polygons that make up all the Soil Mapping Units (SMU) (i.e. soil associations).
- The level of details must correspond to that of a map at 1:1,000,000 nominal scale (polygons must not cover less than 25 km^2).
- Coverage SOIL must have a polygon topology.

- Coverage SOIL is unprojected, i.e. its projection is defined as geographic and its units are defined as decimal degrees of latitude and longitude.
- Each SMU must be represented on the map by one or more polygons.
- Each polygon belongs to one and only one SMU.
- Note that after border harmonisation, polygons may cross over country boundaries.

2.3 ARCINFO® ATTRIBUTE TABLE SOIL.PAT

- The **SOIL.PAT** table is the polygon attribute table for coverage SOIL.
- It holds one record (line) for the description of each polygon in the coverage (plus one record for the "universe" polygon).
- Its key attribute (unique identifier of each record) is SOIL#.
- The table is sorted on attribute SOIL# in ascending order. That order must always be respected to avoid corruption of coverage SOIL.
- The following table provides a summary description of the attributes held in table SOIL.PAT:

NAME	DESCRIPTION	TYPE	SIZE
AREA	Area of the polygon. It is computed by ArcInfo® and should not be filled in by users. Units are not meaningful in a geographic latitude/longitude co-ordinate system.	Real number	8.3
PERIMETER	Perimeter of the polygon. It is computed by ArcInfo® and should not be filled in by users. Units are not meaningful in a geographic latitude/longitude co-ordinate system.	Real number	8.3
SOIL#	ArcInfo® internal identifier of the polygon. It is computed by ArcInfo® and should not be filled in by users. Key attribute of SOIL.PAT. The value of SOIL# is a number in sequence.	Integer number	5
SOIL-ID	User's identifier of the polygon. It is computed by ArcInfo® and should not be filled in by users. It has no particular meaning to users, and may be ignore.	Integer number	5
SMU	Identifier of the Soil Mapping Unit (SMU) to which the polygon belongs. Must be filled in by contributors.	Integer number	7

- Attributes **AREA, PERIMETER, SOIL# and SOIL-ID** are standard ArcInfo® polygon coverage processing attributes. The user does not care about them at the database construction stage. Their values will automatically be computed by ArcInfo®. They can be useful to users in the later stages of mapping and analysis. They are listed here only because they are required by coverage editing tools and need no more detailed description than that given in the table above.

Description of the IDENTIFIER of the SMU

- The **SMU** attribute holds the identifying number of the Soil Mapping Unit (SMU) to which the polygon belongs.
- This is the only attribute in table SOIL.PAT that the user should care about during the database construction stage.
- Each SMU identifier is a link to corresponding SMU identifier in table STU.ORG. Hence, attribute **SMU** has the same meaning and characteristics in both tables.
- Remember that each SMU must be delineated on the map by one or more polygons.
- Remember also that each polygon belongs to one and only one SMU.
- Note that after border harmonisation, an **SMU** can be present in more than one country.
- The domain of authorised values for attribute **SMU** is any integer number in the interval [-2,9999999].

- The following table holds the coding scheme for attribute **SMU**:

SMU values and their meaning	
-2	No information
-1	Out of surveyed area
0	Background polygon (also called "universe" polygon)
1	SMU number 1
2	SMU number 2
...	…
5694	SMU number 5694
…	…

2.4 INFO® FILE STU.ORG

- The **STU.ORG** table describes the organisation (arrangement) of Soil Typological Units (STU) within each Soil Mapping Unit (SMU). Each record stores information about the relationship between an SMU and one of its component STU. Each set of records with the same SMU number provides the list of STUs that compose that SMU.
- Its key attributes are **SMU** and **STU** (their combined values are the unique identifier of each record).
- Remember that each SMU must contain at least one STU.
- It is recommended that each SMU should not contain more than 5 STUs.
- Remember that each STU must be contained in at least one SMU.
- Remember that each STU could be contained in more than one SMU.
- The table is sorted on: **SMU** (ascending order) and **PCAREA** (descending order).
- The following table provides a summary description of the attributes held in table STU.ORG:

NAME	DESCRIPTION	TYPE	SIZE
SMU	Soil Mapping Unit (SMU) identifier.	Integer number	7
STU	Soil Typological Unit (STU) identifier.	Integer number	7
PCAREA	Percentage of area of the Soil Mapping Unit (SMU) covered by the Soil Typological Unit (STU).	Integer number	3

- For each of these attributes, a detailed description is provided hereafter.

Description of the IDENTIFIER of the SMU

- See ArcInfo® Attribute table SOIL.PAT above *on page 10*.

Description of the IDENTIFIER of the STU

- The **STU** attribute holds the identifying number of a component Soil Typological Unit (STU) of the SMU.
- Each STU identifier is a link to the corresponding STU identifier in table STU. Hence, attribute **STU** has the same meaning and characteristics in both tables.
- The number of STUs within a SMU is not limited, but a maximum of 5 STUs per SMU is recommended.
- The range of authorised values for attribute **STU** is any integer number in the interval [1,9999999].

- The following table holds the coding scheme for attribute **STU**:

STU values and their meaning	
1	STU number 1
2	STU number 2
…	...
3876	STU number 3876
3877	STU number 3877
…	…

Description of the PROPORTION of the STU within the SMU

- The **PCAREA** attribute holds the area percentage of the Soil Mapping Unit (SMU) covered by the Soil Typological Unit (STU) as estimated by the soil surveyor. Each element in the list of component STUs is given an estimate of the area percentage of the SMU covered by the STU.
- The sum of percentages for STUs in each SMU must be equal to 100 %.
- Each STU must cover at least 5 % of the total area of the SMU. Any STU under this threshold value should be ignored.
- The range of authorised values for attribute **PCAREA** includes any integer number in interval [5,100], but it is recommended to round up values to multiples of 5 % (e.g. 5, 10, 15…90, 95 and 100 %).
- The following table holds the coding scheme for attribute **PCAREA**:

PCAREA values and their meaning	
5	STU covers 5 % of the SMU
10	STU covers 10 % of the SMU
…	...
95	STU covers 95 % of the SMU
100	STU covers 100 % of the SMU (SMU is "pure")

2.5 INFO® FILE STU

- The **STU** table contains Soil Typological Units (STU) descriptions. It holds one record (line) for the description of each STU.
- Its key attribute (unique identifier for each record) is **STU**.
- The table will be sorted on attribute **STU** in ascending order.
- Note that after border harmonisation, a STU may be present in more than one country.
- The following table provides a summary description of the attributes held in table STU:

NAME	DESCRIPTION	TYPE	SIZE
STU	Soil Typological Unit (STU) identifying number.	Integer number	7
WRB-GRP	Soil Group code of the STU from the World Reference Base (WRB) for Soil Resources.	Character string	2
WRB-ADJ	Soil Adjective code of the STU from the World Reference Base (WRB) for Soil Resources.	Character string	2
WRB-SPE	Complementary code of the STU from the World Reference Base (WRB) for Soil Resources.	Character string	3
FAO90-MG	Soil Major Group code of the STU from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	2
FAO90-UNI	Soil Unit code of the STU from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	1
FAO90-SUB	Soil Sub-unit code of the STU from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	1
SLOPE-DOM	Dominant slope class of the STU.	Integer number	1

SLOPE-SEC	Secondary slope class of the STU.	Integer number	1
ZMIN	Minimum elevation above sea level of the STU (in metres).	Integer number	4
ZMAX	Maximum elevation above sea level of the STU (in metres).	Integer number	4
PAR-MAT-DOM	Code for dominant parent material of the STU.	Integer number	4
PAR-MAT-SEC	Code for secondary parent material of the STU.	Integer number	4
USE-DOM	Code for dominant land use of the STU.	Integer number	2
USE-SEC	Code for secondary land use of the STU.	Integer number	2
AGLIM1	Code for dominant limitation to agricultural use of the STU.	Integer number	2
AGLIM2	Code for secondary limitation to agricultural use of the STU.	Integer number	2
TEXT-SRF-DOM	Dominant surface textural class of the STU.	Integer number	1
TEXT-SRF-SEC	Secondary surface textural class of the STU.	Integer number	1
TEXT-SUB-DOM	Dominant sub-surface textural class of the STU.	Integer number	1
TEXT-SUB-SEC	Secondary sub-surface textural class of the STU.	Integer number	1
TEXT-DEP-CHG	Depth class to a textural change of the dominant and/or secondary surface texture of the STU.	Integer number	1
ROO	Depth class of an obstacle to roots within the soil profile of the STU.	Integer number	1
IL	Depth class of a presence of an impermeable layer within the soil profile of the STU.	Integer number	1
WR	Dominant annual average soil water regime class of the soil profile of the STU.	Integer number	1
WM1	Code for normal presence and purpose of an existing water management system in agricultural land on more than 50 % of the STU.	Integer number	1
WM2	Code for the type of an existing water management system.	Integer number	2
CFL	Code for a global confidence level of the STU description.	Character string	1

- For each group of attributes, a detailed description is provided hereafter.

Description of the IDENTIFIER of the STU

- The **STU** attribute holds the identifying number of the Soil Typological Unit (STU) described.
- Each STU identifier is a link to the corresponding STU identifier in table STU.ORG. Hence, attribute **STU** has the same meaning and characteristics in both tables.
- The range of authorised values for attribute **STU** is any integer number in the interval [1,9999999].
- The following table presents the coding scheme for attribute **STU**:

STU values and their meaning	
1	STU number 1
2	STU number 2
…	...
3876	STU number 3876
3877	STU number 3877
…	…

Description of the WRB SOIL NAME of the STU

- The Scientific Committee of the European Soil Bureau decided to use both the World Reference Base (WRB) for Soil Resources (FAO *et al.*, 1998), as recommended by the International Union of Soil Science (IUSS), and the 1990 FAO-UNESCO Soil Revised Legend (FAO *et al.*, 1990) for defining soil names of STUs. Nevertheless, WRB is the most important reference for harmonisation.
- The following three attributes provide a WRB soil code for each STU:

WRB-GRP	Soil Group code of the STU taken from the World Reference Base (WRB) for Soil Resources.
WRB-ADJ	Soil Adjective code of the STU taken from the World Reference Base (WRB) for Soil Resources.
WRB-SPE	Complementary code of the STU taken from the World Reference Base (WRB) for Soil Resources.

- Together, the three attributes make up the **full WRB soil code** of the STU taken from the World Reference Base (WRB) for Soil Resources.
- To be complete, the full WRB soil code must include at least a value for **WRB-GRP** and **WRB-ADJ**. Both are mandatory and must be filled in. The **WRB-SPE** attribute adds some more information.
- The **WRB-GRP** (Soil Group) attribute must be filled in with a code selected in the first table below. The **WRB-ADJ** (Soil Adjective) must be filled in with a code selected in the second table below. The **WRB-SPE** attribute may be used to code the Soil Specifier taken from the third table below. If no specifier is present, this attribute (**WRB-SPE**) can also be used to code a second Soil Adjective selected in the second table below. See following examples.
- The full soil code reads from the combination of the 3 levels of codification. The following examples illustrate this:
  No Specifier:
  *WRB-GRP = **AC** and WRB-ADJ = **fr** and WRB-SPE = **blank** →full code = **ACfr** = ferric Acrisol*
  *WRB-GRP = **CM** and WRB-ADJ = **gt** and WRB-SPE = **blank** →full code = **CMgt** = gelistagnic Cambisol*
  With a specifier taken from the third table below:
  *WRB-GRP = **AR** and WRB- ADJ = **sz** and WRB-SPE = **w** →full code = **ARszw** = hyposalic Arenosol*
  With two adjectives:
  *WRB-GRP = **CM** and WRB- ADJ =**an** and WRB-SPE =**dy** →full code = **CMandy** = dystric andic Cambisol*
- The list of authorised codes and the corresponding names used to characterise soils in the WRB for Soil Resources is given in the following three tables for attributes **WRB-GRP, WRB-ADJ** and **WRB-SPE**.
- Note that **WRB-GRP** and **WRB-ADJ** may not be blank (uninformed). Only **WRB-SPE** may remain blank when that level of detail is not available.
- Note the coding scheme for non soils at the end of each table (e.g. towns, water bodies, etc.).

WRB-GRP codes and their meaning					
AC	Acrisol	**FL**	Fluvisol	**PZ**	Podzol
AB	Albeluvisol	**GL**	Gleysol	**RG**	Regosol
AL	Alisol	**GY**	Gypsisol	**SC**	Solonchak
AN	Andosol	**HS**	Histosol	**SN**	Solonetz
AT	Anthrosol	**KS**	Kastanozem	**UM**	Umbrisol
AR	Arenosol	**LP**	Leptosol	**VR**	Vertisol
CL	Calcisol	**LX**	Lixisol	**1**	Town
CM	Cambisol	**LV**	Luvisol	**2**	Soil disturbed by man
CH	Chernozem	**NT**	Nitisol	**3**	Water body
CR	Cryosol	**PH**	Phaeozem	**4**	Marsh
DU	Durisol	**PL**	Planosol	**5**	Glacier
FR	Ferralsol	**PT**	Plinthosol	**6**	Rock outcrops

WRB-ADJ codes and their meaning (could be used also for WRB-SPE if needed)							
ap	Abruptic	**fr**	Ferric	**mz**	Mazic	**rs**	Rustic
ae	Aceric	**fi**	Fibric	**me**	Melanic	**sz**	Salic
ac	Acric	**fv**	Fluvic	**ms**	Mesotrophic	**sa**	Sapric
ao	Acroxic	**fo**	Folic	**mo**	Mollic	**si**	Silic
ab	Albic	**fg**	Fragic	**na**	Natric	**sl**	Siltic
ax	Alcalic	**fu**	Fulvic	**ni**	Nitic	**sk**	Skeletic
al	Alic	**ga**	Garbic	**oh**	Ochric	**so**	Sodic
au	Alumic	**ge**	Gelic	**om**	Ombric	**sd**	Spodic
an	Andic	**gt**	Gelistagnic	**or**	Orthic	**sp**	Spolic
aq	Anthraquic	**gr**	Geric	**oa**	Oxyaquic	**st**	Stagnic
am	Anthric	**gi**	Gibbsic	**ph**	Pachic	**su**	Sulphatic
ah	Anthropic	**gc**	Glacic	**pe**	Pellic	**ty**	Takyric
ar	Arenic	**gl**	Gleyic	**pt**	Petric	**tf**	Tephric
ai	Aric	**gs**	Glossic	**pc**	Petrocalcic	**tr**	Terric
ad	Aridic	**gz**	Greyic	**pd**	Petroduric	**ti**	Thionic
az	Arzic	**gm**	Grumic	**pg**	Petrogypsic	**tx**	Toxic
ca	Calcaric	**gy**	Gypsic	**pp**	Petroplinthic	**tu**	Turbic
cc	Calcic	**gp**	Gypsiric	**ps**	Petrosalic	**um**	Umbric
cb	Carbic	**ha**	Haplic	**pi**	Placic	**ub**	Urbic
cn	Carbonatic	**hi**	Histic	**pa**	Plaggic	**vm**	Vermic
ch	Chernic	**ht**	Hortic	**pn**	Planic	**vr**	Vertic
cl	Chloridic	**hu**	Humic	**pl**	Plinthic	**vt**	Vetic
cr	Chromic	**hg**	Hydragric	**po**	Posic	**vi**	Vitric
cy	Cryic	**hy**	Hydric	**pf**	Profondic	**xa**	Xanthic
ct	Cutanic	**hk**	Hyperskeletic	**pr**	Protic	**ye**	Yermic
dn	Densic	**ir**	Irragric	**rd**	Reductic	**1**	Town
du	Duric	**ll**	Lamellic	**rg**	Regic	**2**	Soil disturbed by man
dy	Dystric	**le**	Leptic	**rz**	Rendzic	**3**	Water body
et	Entic	**li**	Lithic	**rh**	Rheic	**4**	Marsh
eu	Eutric	**lx**	Lixic	**ro**	Rhodic	**5**	Glacier
es	Eutrisilic	**lv**	Luvic	**ru**	Rubic	**6**	Rock outcrops
fl	Ferralic	**mg**	Magnesic	**rp**	Ruptic		

WRB-SPE codes and their meaning					
d	Bathi	**r**	Para	**1**	Town
c	Cumuli	**t**	Proto	**2**	Soil disturbed by man
n	Endo	**b**	Thapto	**3**	Water body
p	Epi			**4**	Marsh
h	Hyper			**5**	Glacier
w	Hypo			**6**	Rock outcrops
o	Orthi				No information

Description of the 1990 FAO-UNESCO legend SOIL NAME of the STU

- *Reminder*: the Scientific Committee of the European Soil Bureau decided to use both the World Reference Base (WRB) for Soil Resources (FAO *et al.*, 1998), as recommended by the International Union of Soil Science (IUSS), and the 1990 FAO-UNESCO Soil Revised Legend (FAO *et al.*, 1990) for defining soil names of the STUs. Nevertheless, WRB is the most important reference for harmonisation.

- The following three attributes provide an FAO 1990 soil code for each STU:

FAO90-MG	Soil Major Group code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.
FAO90-UNI	Soil Unit code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.
FAO90-SUB	Soil Sub-unit code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.

- All together, the three attributes make up the **full soil code** of the STU following the 1990 FAO-UNESCO Soil Revised Legend guidelines. The full soil code is a result of the combination of the 3 levels of codification.
- To be considered as sufficiently complete, the full soil code must include at least the value for the soil major group (**FAO90-MG**) and that for the soil unit (**FAO90-UNI**). Although not mandatory, entering a value for the sub-unit (**FAO90-SUB**) adds more information to the soil code (see details and examples below).
- The list of authorised codes and their corresponding meaning is given in the following combined table for attributes **FAO90-MG** and **FAO90-UNI**.
- Note that **FAO90-MG** and **FAO90-UNI** cannot remain blank. The information is mandatory. Only **FAO90-SUB** may remain blank when that level of detail is not available.
- Note the coding scheme for non soils at the end of the table (e.g. towns, water bodies, etc.).

FAO90-MG codes and their meaning		**FAO90-UNI codes and their meaning when combined with FAO90-MG**	
AC	**Acrisol**	f	Ferric Acrisol
AC	Acrisol	g	Gleyic Acrisol
AC	Acrisol	h	Haplic Acrisol
AC	Acrisol	p	Plinthic Acrisol
AC	Acrisol	u	Humic Acrisol
AL	**Alisol**	f	Ferric Alisol
AL	Alisol	g	Gleyic Alisol
AL	Alisol	h	Haplic Alisol
AL	Alisol	j	Stagnic Alisol
AL	Alisol	p	Plinthic Alisol
AL	Alisol	u	Humic Alisol
AN	**Andosol**	g	Gleyic Andosol
AN	Andosol	h	Haplic Andosol
AN	Andosol	i	Gelic Andosol
AN	Andosol	m	Mollic Andosol
AN	Andosol	u	Umbric Andosol
AN	Andosol	z	Vitric Andosol
AT	**Anthrosol**	a	Aric Anthrosol
AT	Anthrosol	c	Cumulic Anthrosol
AT	Anthrosol	f	Fimic Anthrosol
AT	Anthrosol	u	Urbic Anthrosol
AR	**Arenosol**	a	Albic Arenosol
AR	Arenosol	b	Cambic Arenosol
AR	Arenosol	c	Calcaric Arenosol
AR	Arenosol	g	Gleyic Arenosol
AR	Arenosol	h	Haplic Arenosol
AR	Arenosol	l	Luvic Arenosol
AR	Arenosol	o	Ferralic Arenosol
CL	**Calcisol**	h	Haplic Calcisol
CL	Calcisol	l	Luvic Calcisol
CL	Calcisol	p	Petric Calcisol

CM	**Cambisol**	c	Calcaric Cambisol
CM	Cambisol	d	Dystric Cambisol
CM	Cambisol	j	Stagnic Cambisol
CM	Cambisol	e	Eutric Cambisol
CM	Cambisol	g	Gleyic Cambisol
CM	Cambisol	i	Gelic Cambisol
CM	Cambisol	o	Ferralic Cambisol
CM	Cambisol	u	Humic Cambisol
CM	Cambisol	v	Vertic Cambisol
CM	Cambisol	x	Chromic Cambisol
CH	**Chernozem**	g	Gleyic Chernozem
CH	Chernozem	h	Haplic Chernozem
CH	Chernozem	k	Calcic Chernozem
CH	Chernozem	l	Luvic Chernozem
CH	Chernozem	w	Glossic Chernozem
FR	**Ferralsol**	g	Geric Ferralsol
FR	Ferralsol	h	Haplic Ferralsol
FR	Ferralsol	p	Plinthic Ferralsol
FR	Ferralsol	r	Rhodic Ferralsol
FR	Ferralsol	u	Humic Ferralsol
FR	Ferralsol	x	Xanthic Ferralsol
FL	**Fluvisol**	c	Calcaric Fluvisol
FL	Fluvisol	d	Dystric Fluvisol
FL	Fluvisol	e	Eutric Fluvisol
FL	Fluvisol	m	Mollic Fluvisol
FL	Fluvisol	s	Salic Fluvisol
FL	Fluvisol	t	Thionic Fluvisol
FL	Fluvisol	u	Umbric Fluvisol
GL	**Gleysol**	a	Andic Gleysol
GL	Gleysol	d	Dystric Gleysol
GL	Gleysol	e	Eutric Gleysol
GL	Gleysol	i	Gelic Gleysol
GL	Gleysol	k	Calcic Gleysol
GL	Gleysol	m	Mollic Gleysol
GL	Gleysol	t	Thionic Gleysol
GL	Gleysol	u	Umbric Gleysol
GR	**Greyzem**	g	Gleyic Greyzem
GR	Greyzem	h	Haplic Greyzem
GY	**Gypsisol**	h	Haplic Gypsisol
GY	Gypsisol	k	Calcic Gypsisol
GY	Gypsisol	l	Luvic Gypsisol
GY	Gypsisol	p	Petric Gypsisol
HS	**Histosol**	f	Fibric Histosol
HS	Histosol	i	Gelic Histosol
HS	Histosol	l	Folic Histosol
HS	Histosol	s	Terric Histosol
HS	Histosol	t	Thionic Histosol
KS	**Kastanozem**	h	Haplic Kastanozem
KS	Kastanozem	k	Calcic Kastanozem
KS	Kastanozem	l	Luvic Kastanozem
KS	Kastanozem	y	Gypsic Kastanozem
LP	**Leptosol**	d	Dystric Leptosol
LP	Leptosol	e	Eutric Leptosol
LP	Leptosol	i	Gelic Leptosol
LP	Leptosol	k	Rendzic Leptosol
LP	Leptosol	m	Mollic Leptosol
LP	Leptosol	q	Lithic Leptosol
LP	Leptosol	u	Umbric Leptosol

LX	**Lixisol**	a	Albic Lixisol
LX	Lixisol	f	Ferric Lixisol
LX	Lixisol	g	Gleyic Lixisol
LX	Lixisol	h	Haplic Lixisol
LX	Lixisol	j	Stagnic Lixisol
LX	Lixisol	p	Plinthic Lixisol
LV	**Luvisol**	a	Albic Luvisol
LV	Luvisol	f	Ferric Luvisol
LV	Luvisol	g	Gleyic Luvisol
LV	Luvisol	h	Haplic Luvisol
LV	Luvisol	j	Stagnic Luvisol
LV	Luvisol	k	Calcic Luvisol
LV	Luvisol	v	Vertic Luvisol
LV	Luvisol	x	Chromic Luvisol
NT	**Nitisol**	h	Haplic Nitisol
NT	Nitisol	r	Rhodic Nitisol
NT	Nitisol	u	Humic Nitisol
PH	**Phaeozem**	c	Calcaric Phaeozem
PH	Phaeozem	g	Gleyic Phaeozem
PH	Phaeozem	h	Haplic Phaeozem
PH	Phaeozem	j	Stagnic Phaeozem
PH	Phaeozem	l	Luvic Phaeozem
PL	**Planosol**	d	Dystric Planosol
PL	Planosol	e	Eutric Planosol
PL	Planosol	i	Gelic Planosol
PL	Planosol	m	Mollic Planosol
PL	Planosol	u	Umbric Planosol
PT	**Plinthosol**	a	Albic Plinthosol
PT	Plinthosol	d	Dystric Plinthosol
PT	Plinthosol	e	Eutric Plinthosol
PT	Plinthosol	u	Humic Plinthosol
PZ	**Podzol**	b	Cambic Podzol
PZ	Podzol	c	Carbic Podzol
PZ	Podzol	f	Ferric Podzol
PZ	Podzol	g	Gleyic Podzol
PZ	Podzol	h	Haplic Podzol
PZ	Podzol	i	Gelic Podzol
PD	**Podzoluvisol**	d	Dystric Podzoluvisol
PD	Podzoluvisol	e	Eutric Podzoluvisol
PD	Podzoluvisol	g	Gleyic Podzoluvisol
PD	Podzoluvisol	i	Gelic Podzoluvisol
PD	Podzoluvisol	j	Stagnic Podzoluvisol
RG	**Regosol**	c	Calcaric Regosol
RG	Regosol	d	Dystric Regosol
RG	Regosol	e	Eutric Regosol
RG	Regosol	i	Gelic Regosol
RG	Regosol	u	Umbric Regosol
RG	Regosol	y	Gypsic Regosol
SC	**Solonchak**	g	Gleyic Solonchak
SC	Solonchak	h	Haplic Solonchak
SC	Solonchak	i	Gelic Solonchak
SC	Solonchak	k	Calcic Solonchak
SC	Solonchak	m	Mollic Solonchak
SC	Solonchak	n	Sodic Solonchak
SC	Solonchak	y	Gypsic Solonchak
SN	**Solonetz**	g	Gleyic Solonetz
SN	Solonetz	h	Haplic Solonetz
SN	Solonetz	j	Stagnic Solonetz
SN	Solonetz	k	Calcic Solonetz
SN	Solonetz	m	Mollic Solonetz
SN	Solonetz	y	Gypsic Solonetz

VR	**Vertisol**	d	Dystric Vertisol
VR	Vertisol	e	Eutric Vertisol
VR	Vertisol	k	Calcic Vertisol
VR	Vertisol	y	Gypsic Vertisol
1	Town	1	Town
2	Soil disturbed by man	2	Soil disturbed by man
3	Water body	3	Water body
4	Marsh	4	Marsh
5	Glacier	5	Glacier
6	Rock outcrops	6	Rock outcrops

- It is obvious that for more detailed mapping or information, a need arises for the definition of **soil sub-units** at a third level.
  As written in the FAO-WSR Report 60 (Soil map of the world. Revised Legend – FAO *et al.*, 1990), *"... the sub-units should be very clearly defined, and their definitions should not overlap and should not conflict with the definitions at the first and second level. The symbols to use for sub-units are those of the relevant soil unit with, in addition, a second lower case letter indicating the third level specification. The choice of letters is limited, and the same letters will need to be used with different meanings".*
  Attribute **FAO90-SUB** is there to hold the code for that third level of detail in the soil name.
- The full soil code reads from the combination of the 3 levels of codification. For example a *Niti-calcaric Cambisol* belongs to the Cambisol major group (Soil Major Group), has calcaric characteristics (Soil Unit) and nitic characteristics (Soil Sub-unit). In other words:
  FAO90-MG = ***CM*** *and FAO90-UNI =* ***c*** *and FAO90-SUB =* ***n*** *→full code =* ***CMcn*** *= Niti-calcaric Cambisol*
  Other examples include:
  FAO90-MG = ***AC*** *and FAO90-UNI =* ***u*** *and FAO90-SUB =* ***a*** *→full code =* ***ACua*** *= Alumi-humic Acrisol*
  FAO90-MG = ***AC*** *and FAO90-UNI =* ***f*** *and FAO90-SUB =* ***blank*** *→full code =* ***ACf*** *= Ferric Acrisol*
- The meaning of the lower case letter indicating the third level depends on the context defined by **FAO90-MG** and **FAO90-UNI**. See examples below.

Examples of FAO90-SUB codes and their meaning when combined with FAO90-MG and FAO90-UNI	
a	Areni-albic Lixisol (LXaa)
a	Antraqui-stagnic Solonetz (SNja)
e	Eutri-haplic Andosol (ANhe)
e	Epi-gleyic Podzol (PZge)
u	Umbri-humic Alisol (ALuu)
u	Humi-dystric Cambisol (CMdu)
u	Humi-dystric Podzoluvisol (PDdu)
…	etc.
1	Town
2	Soil disturbed by man
3	Water body
4	Marsh
5	Glacier
6	Rock outcrops
	No information

Description of the SLOPES of the STU.

- The following two attributes are used to describe the general topography of the STU:

SLOPE-DOM	Dominant slope class of the STU.
SLOPE-SEC	Secondary slope class of the STU.

- The **SLOPE-SEC** attribute provides an option to indicate a secondary slope class when slope variability within an STU is important and some parts of the STU fall into a different slope class than that of the dominant one. If there is no variability or if the variability is unknown, the value of **SLOPE-DOM** must be copied to **SLOPE-SEC** (see also *section 1.3.3 on page 6*).

- The list of authorised codes and their corresponding meaning is given in the following table for attributes **SLOPE-DOM** and **SLOPE-SEC**:

SLOPE-DOM and SLOPE-SEC codes and their meaning	
0	No information
1	Level (dominant slope ranging from 0 to 8 %)
2	Sloping (dominant slope ranging from 8 to 15 %)
3	Moderately steep (dominant slope ranging from 15 to 25 %)
4	Steep (dominant slope over 25 %)

Description of the ELEVATION of the STU

- The following two attributes also contribute to provide a general idea of the topography of the STU:

ZMIN Minimum above sea level elevation of the STU (in metres).
ZMAX Maximum above sea level elevation of the STU (in metres).

- It is often difficult to fill in the information concerning **ZMIN** and **ZMAX** attributes. This is particularly true when the map coverage is a generalisation of previous maps that were not very detailed themselves. The use of a Digital Elevation Model (DEM) will often palliate the lack of information for these attributes. Using a DEM will however apply to the whole Soil Mapping Unit, and not to the individual STU components, as required here. Hence, the information should be provided if available from the soil survey.
- The range of authorised values for attributes **ZMIN** and **ZMAX** is an integer number selected in the interval [-400,9999]. –999 is the code used when no information is available. The negative values in the interval are given since some areas, such as the Caspian or Dead Seas, are below the general ocean level.
- The following table holds the coding scheme for attributes **ZMIN** and **ZMAX**:

ZMIN and ZMAX values and their meaning	
-999	No information
...	…
-2	-2 metres
-1	-1 metres
0	0 metre
1	1 metre
2	2 metres
…	…
5000	5000 metres

Description of the PARENT MATERIALS of the STU

- The parent material code must be selected from the list provided below. This list has evolved from a number of approximations using experiences from several pilot projects. The current version has been modified from the version originally prepared by ESB (1998) for the Georeferenced Soil Database for Europe at 1:250,000, following the modifications of Hartwich (1995). As in the Manual of Procedures Version 1.1 for the 1:250,000 Georeferenced Soil Database, this list includes four levels: Major Class, Group, Type and Subtype (see ESB1999a, 1999b, 2001).
- The following two attributes provide a description for the parent material of the STU:

PAR-MAT-DOM Dominant parent material code of the STU.
PAR-MAT-SEC Secondary parent material code of the STU.

- The **PAR-MAT-SEC** attribute provides the option to indicate a secondary parent material code when parent material variability within an STU is important and some parts of the STU fall into a different parent material class than that of the dominant one.
  If there is no variability or if the variability is unknown, the value of **PAR-MAT-DOM** must be copied to **PAR-MAT-SEC** (see also *section 1.3.3 on page 6*).
- The list of authorised codes and their corresponding meaning is given in the following table for attributes **PAR-MAT-DOM** and **PAR-MAT-SEC**.
- Depending on the level of detail available to describe the dominant and secondary parent materials of the STU, i.e. Major Class or Group or Type or Sub-type, the user will choose any one of the codes provided in the table.
  Whenever possible, it is recommended to identify as precisely as possible the exact type of parent material, using the full 4-digit code. For example, *calcareous sandstone (1211)* is preferable to *sandstone (1210)* or to *psammite (1200*). The later should be used either if the type of sandstone has not been precisely defined on the soil maps, or when more than one type of sandstones is present in the STU.

PAR-MAT-DOM and PAR-MAT-SEC codes and their meaning							
Major Class level		**Group level**		**Type level**		**Sub-type level**	
0000	No information	0000	No information	0000	No information	0000	No information
1000	consolidated-clastic-sedimentary rocks	1100	psephite or rudite	1110	conglomerate	1111	pudding stone
				1120	breccia		
		1200	psammite or arenite	1210	sandstone	1211	calcareous sandstone
						1212	ferruginous sandstone
						1213	clayey sandstone
						1214	quartzitiic sandstone orthoquartzite
						1215	micaceous sandstone
				1220	arkose		
				1230	graywacke	1231	feldspathic graywacke
		1300	pelite, lutite or argilite	1310	claystone / mudstone	1311	kaolinite
						1312	bentonite
				1320	siltstone		
		1400	facies bound rock	1410	flysch	1411	sandy flisch
						1412	clayey and silty flysch
						1413	conglomeratic flysch
				1420	molasse		
2000	sedimentary rocks (chemically precipitated, evaporated, or organogenic or biogenic in origin)	2100	calcareous rocks	2110	limestone	2111	hard limestone
						2112	soft limestone
						2113	marly limestone
						2114	chalky limestone
						2115	detrital limestone
						2116	carbonaceous limestone
						2117	lacustrine or freshwater limestone
						2118	travertine/calcareous sinter
						2119	cavernous limestone
				2120	dolomite	2121	cavernous dolomite
						2122	calcareous dolomite
				2130	marlstone		
				2140	marl	2141	chalk marl
						2142	gypsiferous marl
				2150	chalk		
		2200	evaporites	2210	gypsum		
				2220	anhydrite		
				2230	halite		
		2300	siliceous rocks	2310	chert, hornstone, flint		
				2320	diatomite radiolarite		

3000	igneous rocks	3100	acid to intermediate plutonic rocks	3110	granite		
				3120	granodiorite		
				3130	diorite	3131	quartz diorite
						3132	gabbro diorite
				3140	syenite	3140	syenite
		3200	basic plutonic rocks	3210	gabbro	3210	gabbro
		3300	ultrabasic plutonic rocks	3310	peridotite	3310	peridotite
				3320	pyroxenite	3320	pyroxenite
		3400	acid to intermediate volcanic rocks	3410	rhyolite	3411	obsidian
						3412	quartz porphyrite
				3420	dacite		
				3430	andesite	3431	porphyrite (interm,)
				3440	phonolite	3441	tephritic phonolite
				3450	trachyte		
		3500	basic to ultrabasic volcanic rocks	3510	basalt		
				3520	diabase		
				3530	pikrite		
		3600	dike rocks	3610	aplite		
				3620	pegmatite		
				3630	lamprophyre		
		3700	pyroclastic rocks (tephra)	3710	tuff/tuffstone	3711	agglomeratic tuff
						3712	block tuff
						3713	lapilli tuff
				3720	tuffite	3721	sandy tuffite
						3722	silty tuffite
						3723	clayey tuffite
				3730	volcanic scoria/ volcanic breccia		
				3740	volcanic ash		
				3750	ignimbrite		
				3760	pumice		
4000	metamorphic rocks	4100	weakly metamorphic rocks	4110	(meta-)shale / argilite		
				4120	slate	4121	graphitic slate
		4200	acid regional metamorphic rocks	4210	(meta-)quartzite	4211	quartzite schist
				4220	phyllite		
				4230	micaschist		
				4240	gneiss		
				4250	granulite (sensu stricto)		
				4260	migmatite		
		4300	basic regional metamorphic rocks	4310	greenschist	4311	prasinite
						4312	chlorite
						4313	talc schist
				4320	amphibolite		
				4330	eclogite		
		4400	ultrabasic regional metamorphic rocks	4410	serpentinite	4411	greenstone
		4500	calcareous regional metamorphic rocks	4510	marble		
				4520	calcschist, skam		
		4600	rocks formed by contact metamorphism	4610	contact slate	4611	nodular slate
				4620	hornfels		
				4630	calsilicate rocks		
		4700	tectogenetic or cataclasmic metamorphic rocks	4710	tectonic breccia		
				4720	cataclasite		
				4730	mylonite		

5000	unconsolidated deposits (alluvium, weathering residuum and slope deposits)	5100	marine and estuarine sands	5110	pre-quaternary sand	5111	tertiary sand
				5120	quaternary sand	5121	holocene coastal sand with shells
						5122	delta sand
		5200	marine and estuarine clays and silts	5210	pre-quaternary clay and silt	5211	tertiary clay
						5212	tertiary silt
				5220	quaternary clay and silt	5221	holocene clay
						5222	holocene silt
		5300	fluvial sands and gravels	5310	river terrace sand or gravel	5311	river terrace sand
						5312	river terrace gravel
				5320	floodplain sand or	5321	floodplain sand
					gravel or loam or clay and silt	5322	floodplain gravel
						5323	floodplain loam
						5324	floodplain clay and silt
		5400	fluvial clays, silts and loams	5410	river clay and silt	5411	terrace clay and silt
						5412	terrace loam
				5420	overbank deposit	5421	overbank clay and silt
						5422	overbank loam
		5500	lake deposits	5510	lake sand and delta sand		
				5520	lake marl, bog lime		
				5530	lake silt		
		5600	residual and redeposited loams from silicate rocks	5610	residual loam	5611	stony loam
						5612	clayey loam
				5620	redeposited loam	5621	running-ground
		5700	residual and redeposited clays from calcareous rocks	5710	residual clay	5711	clay with flints
						5712	ferruginous residual clay
						5713	calcareous clay
						5714	non-calcareous clay
						5715	marly clay
				5720	redeposited clay	5721	stony clay
		5800	slope deposits	5810	slope-wash alluvium		
				5820	colluvial deposits		
				5830	talus scree	5831	stratified slope deposits
6000	unconsolidated glacial deposits glacial drift	6100	morainic deposits	6110	glacial till	6111	boulder clay
				6120	glacial debris		
		6200	glaciofluvial deposits	6210	outwash sand, glacial sand		
				6220	outwash gravels glacial gravels		
		6300	glaciolacustrine deposits	6310	varves		
7000	eolian deposits	7100	loess	7110	loamy loess		
				7120	sandy loess		
		7200	eolian sands	7210	dune sand		
				7220	cover sand		
8000	organic materials	8100	peat (mires)	8110	rainwater fed moor peat (raised bog)	8111	folic peat
						8112	fibric peat
						8113	terric peat
				8120	groundwater fed bog peat		
		8200	slime and ooze deposits	8210	gyttja, sapropel		
		8300	carbonaceaous rocks (caustobiolite)	8310	lignite (brown coal)		
				8320	hard coal		
				8330	anthracite		

9000	anthropogenic deposits	9100	redeposited natural materials	9110	sand and gravel fill		
				9120	loamy fill		
		9200	dump deposits	9210	rubble/rubbish		
				9220	industrial ashes and slag		
				9230	industrial sludge		
				9240	industrial waste		
		9300	anthropogenic organic materials	9300	anthropogenic organic materials		

Description of the LAND USES of the STU

- The following two attributes are used to describe the main land uses of the STU:

USE-DOM Code for dominant land use within the STU.
USE-SEC Code for secondary land use within the STU.

- **USE-DOM** describes the dominant and most apparent land use for an STU. A second type of land use can be taken into account in **USE-SEC**. The map co-ordinator must use his expert judgement to determine what are the dominant and secondary land uses for an STU, as the soil can cover extensive surfaces in regions with different agricultural practices and crops.
  If there is only one land use or if the variability is unknown, then the value of **USE-DOM** must be copied to **USE-SEC** (see also *section 1.3.3 on page 6*).
- Land uses that do not involve much human intervention, such as wasteland, or wildlife refuge, or land above timberline, are also listed here.
- The list of authorised codes and their corresponding meaning is given in the following table for attributes **USE-DOM** and **USE-SEC**:

USE-DOM and USE-SEC codes and their meaning	
0	No information
1	Pasture, grassland, grazing land
2	Poplars
3	Arable land, cereals
4	Wasteland, shrub
5	Forest, coppice
6	Horticulture
7	Vineyards
8	Garrigue
9	Bush, macchia
10	Moor
11	Halophile grassland
12	Arboriculture, orchard
13	Industrial crops
14	Rice
15	Cotton
16	Vegetables
17	Olive trees
18	Recreation
19	Extensive pasture, grazing, rough pasture
20	Dehesa (extensive pastoral system in forest parks in Spain)
21	Cultivos enarenados (artificial soils for orchards in SE Spain)
22	Wildlife refuge, land above timberline

Description of the LIMITATIONS for AGRICULTURAL USE of the STU

- The following two attributes are used to describe the limitations to agricultural use of the STU:

AGLIM1	Code of the dominant limitation for agricultural use of the STU.
AGLIM2	Code of the secondary limitation for agricultural use of the STU.

- A STU can have more than one limitation for agricultural use. Only the two most important limitations are considered and ranked in order of their relative importance. Attribute **AGLIM1** contains the code of the most important limitation and attribute **AGLIM2** the code of the secondary limitation.
  If there is only one limitation or if the secondary limitation is unknown, then the value of **AGLIM1** must also be copied to **AGLIM2** (see also *section 1.3.3, on page 6*).
  For example, a soil can be both shallow, with a lithic contact within the first 50 cm, and have more than 35 % gravel. The contributor may determine that shallowness is the dominant limiting factor and gravel content is the secondary limitation. Then AGLIM1= 4 and AGLIM2 = 2.
- Recently, duripans and petroferric horizons have been added to the list of limiting factors. These horizons are more often found in soils of the Mediterranean area than in Northern Europe. The major types of chemical and physical limitations for agricultural use are listed below. Most limitations listed here, however, are physical.
- The list of authorised codes and their corresponding meaning is given in the following table for attribute **AGLIM1** and **AGLIM2**:

AGLIM1 and AGLIM2 codes and their meaning	
0	No information
1	No limitation to agricultural use
2	Gravelly (over 35 % gravel diameter < 7.5 cm)
3	Stony (presence of stones diameter > 7.5 cm, impracticable mechanisation)
4	Lithic (coherent and hard rock within 50 cm)
5	Concretionary (over 35 % concretions diameter < 7.5 cm near the surface)
6	Petrocalcic (cemented or indurated calcic horizon within 100 cm)
7	Saline (electric conductivity > 4 $mS.cm^{-1}$ within 100 cm)
8	Sodic (Na/T > 6 % within 100 cm)
9	Glaciers and snow-caps
10	Soils disturbed by man (i.e. landfills, paved surfaces, mine spoils)
11	Fragipans
12	Excessively drained
13	Almost always flooded
14	Eroded phase, erosion
15	Phreatic phase (shallow water table)
16	Duripan (silica and iron cemented subsoil horizon)
17	Petroferric horizon
18	Permafrost

Description of the TEXTURES of the STU

- Texture is divided into 5 major classes corresponding to specific particle-size distribution of clay, silt and sand (CEC, 1985) as shown in *Figure 4*:
  where the following textural classes are used:
  Sand = fraction between 50 and 2000 µm
  Silt = fraction between 2 and 50 µm
  Clay = fraction smaller than 2 µm

Remark*:* Note that specific values for the different fractions should be indicated in the soil profile description tables (see *PART 3, section 3.1.1., on page 37).*

- The following five attributes are used to describe STU textures and the spatial as well as the profile textural variability for the STU.

TEXT-SRF-DOM	Dominant surface textural class of the STU.
TEXT-SRF-SEC	Secondary surface textural class of the STU.
TEXT-SUB-DOM	Dominant sub-surface textural class of the STU.
TEXT-SUB-SEC	Secondary sub-surface textural class of the STU.
TEXT-DEP-CHG	Depth class to a textural change of the dominant and/or secondary surface texture of the STU.

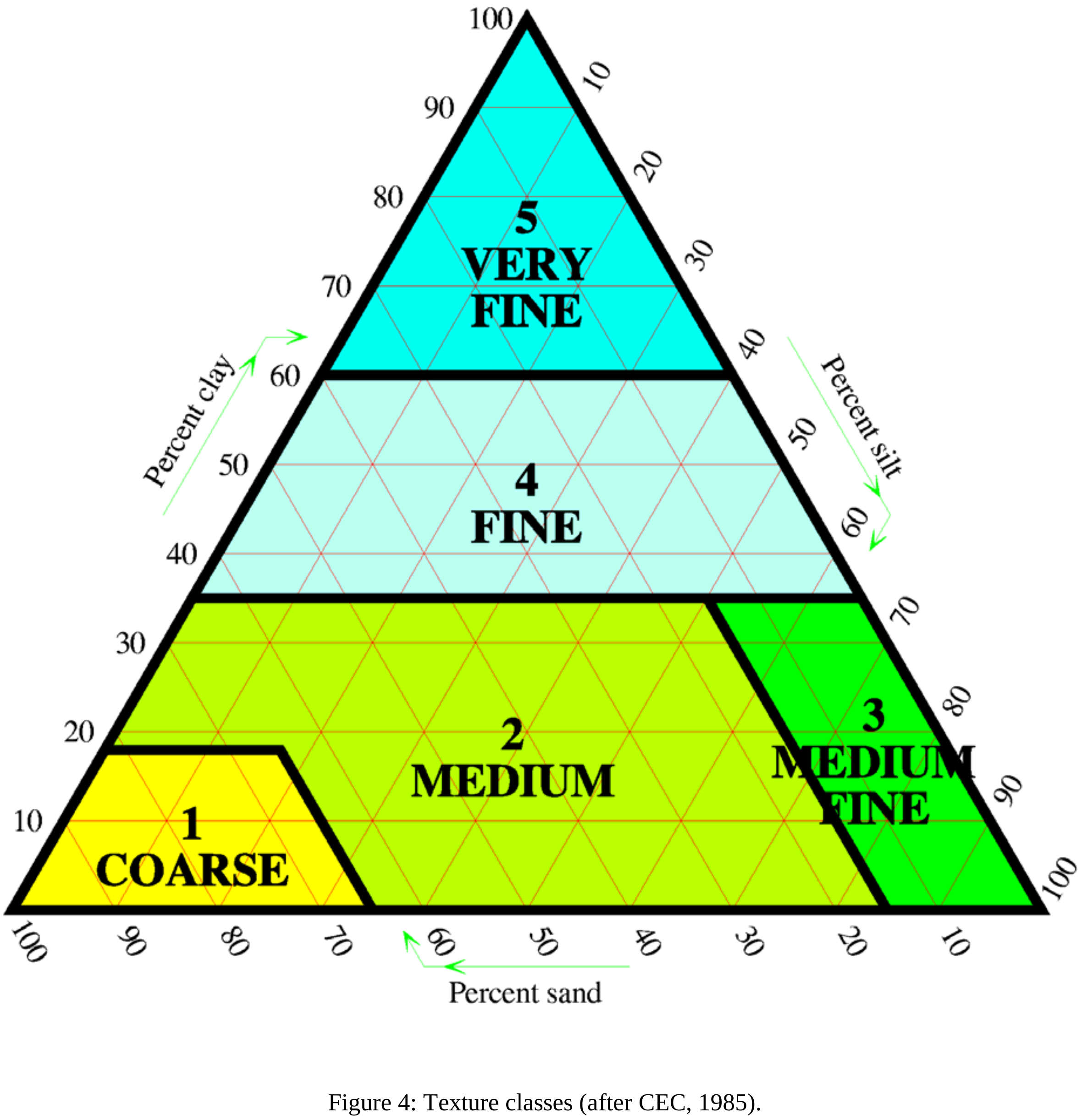

Figure 4: Texture classes (after CEC, 1985).

Expressing lateral variability:

- A STU can have surface textures that fall in two different textural classes. The secondary surface textural class (**TEXT-SRF-SEC**) is used to indicate the surface texture less extensive than the dominant one.
  Together the **TEXT-SRF-DOM** and the **TEXT-SRF-SEC** attributes describe the **lateral variability of the surface horizon texture within the STU**. If there is no such variability or if information is unavailable, then the value of **TEXT-SRF-DOM** must also be entered for **TEXT-SRF-SEC** (see also *section 1.3.3 on page 6*).

- The same remarks stand for attributes **TEXT-SUB-DOM** and **TEXT-SUB-SEC**, i.e. an STU can have contrasted sub-surface textures that fall in two different textural classes. The secondary sub-surface textural class (**TEXT-SUB-SEC**) is used to indicate which sub-surface texture is less extensive than the dominant one.
  Together the **TEXT-SUB-DOM** and the **TEXT-SUB-SEC** attributes reflect the **lateral variability of the sub-surface horizon texture within the STU**. If there is no such variability or if there is no information, the value of **TEXT-SUB-DOM** must also be entered for **TEXT-SUB-SEC** (see also *section 1.3.3 on page 6*).
- The list of authorised codes and their corresponding meaning is given in the following table for attributes **TEXT-SRF-DOM, TEXT-SRF-SEC, TEXT-SUB-DOM** and **TEXT-SUB-SEC**:

TEXT-SRF-DOM, TEXT-SRF-SEC, TEXT-SUB-DOM and TEXT-SUB-SEC **Codes, meaning, and corresponding ranges of values for clay, silt and sand contents**	
0	No information
9	No mineral texture (Peat soils, rocks, etc.)
1	Coarse (clay <18 % and sand >65 %)
2	Medium (18 % < clay < 35 % and sand > 15 %, or clay <18 % and 15 % < sand <65 %)
3	Medium fine (clay <35 % and sand <15 %)
4	Fine (35 % < clay < 60 %)
5	Very fine (clay > 60 %)

<u>Expressing profile variability:</u>

- The depth to a textural change of the dominant and/or secondary surface texture is defined by depth classes (**TEXT-DEP-CHG**).
- The list of authorised codes and their corresponding meaning is given in the following table for attribute **TEXT-DEP-CHG:**

TEXT-DEP-CHG codes and their meaning	
0	No information
1	Textural change between 20 and 40 cm depth
2	Textural change between 40 and 60 cm depth
3	Textural change between 60 and 80 cm depth
4	Textural change between 80 and 120 cm depth
5	No textural change between 20 and 120 cm depth
6	Textural change between 20 and 60 cm depth
7	Textural change between 60 and 120 cm depth

Description of the DEPTH CLASS of an OBSTACLE TO ROOTS of the STU

- An obstacle to roots is defined as a subsoil horizon restricting root penetration. It can be of lithologic origin (lithic contact), or pedogenic origin (fragipan, duripan, petrocalcic or petroferric horizons), or can result from the accumulation of toxic elements, or from waterlogging.
- The **ROO** attribute holds the depth class of an obstacle to roots within the STU.
- The list of authorised codes and their corresponding meaning is given in the following table for attribute **ROO**:

ROO codes and their meaning	
0	No information
1	No obstacle to roots between 0 and 80 cm
2	Obstacle to roots between 60 and 80 cm depth
3	Obstacle to roots between 40 and 60 cm depth
4	Obstacle to roots between 20 and 40 cm depth
5	Obstacle to roots between 0 and 80 cm depth
6	Obstacle to roots between 0 and 20 cm depth

Description of the presence of an IMPERMEABLE LAYER of the STU

- An impermeable layer is a subsoil horizon restricting water penetration. The impermeability can be of lithologic origin (lithic contact), or pedogenic origin (claypan, duripan, petrocalcic or petroferric horizons).
- The **IL** attribute holds the code for the depth class of a presence of an impermeable layer within the soil profile.
- The list of authorised codes and their corresponding meaning is given in the following table for attribute **IL**:

IL codes and their meaning	
0	No information
1	No impermeable layer within 150 cm
2	Impermeable layer between 80 and 150 cm
3	Impermeable layer between 40 and 80 cm
4	Impermeable layer within 40 cm

Description of the SOIL WATER REGIME of the STU

- The annual average soil water regime is an estimate of the soil moisture conditions throughout the year. It is based on time series of matrix suction profiles, or groundwater table depths, or soil morphological attributes, or a combination of these characteristics.
- The annual soil water regime is expressed in terms of duration of the state of soil wetness during the year. A soil is wet when it is saturated and has a matrix suction less than 10 cm, or a matrix potential over -1 kPa. Time is counted in cumulative days and not as successive days of wet conditions.
- The **WR** attribute is used to describe the dominant annual average soil water regime class of the soil profile of the STU.
- The list of authorised codes and their corresponding meaning is given in the following table for attribute **WR**:

WR codes and their meaning	
0	No information
1	Not wet within 80 cm for over 3 months, nor wet within 40 cm for over 1 month
2	Wet within 80 cm for 3 to 6 months, but not wet within 40 cm for over 1 month
3	Wet within 80 cm for over 6 months, but not wet within 40 cm for over 11 months
4	Wet within 40 cm depth for over 11 months

Description of the WATER MANAGEMENT SYSTEM of the STU

- A water management system is intended to palliate the lack of water (dry conditions), correct a soil condition preventing agricultural use (salinity), or drain excess water in waterlogged or frequently flooded areas. In some cases, it has a double purpose, for example in zones with contrasting seasonal conditions, alternatively flooded or experiencing droughts.
- Water management means all various practices of irrigation and drainage, as listed below for attribute **WM2**. The most obvious, apparent, or dominant type of water management system must be chosen from the list according to the contributor's expertise.
- Choose the appropriate codes **if more than 50 % of the STU area is affected**.
- The following two attributes are used to describe the presence, purpose and type of a water management system within the STU:

WM1	Code for the presence and purpose of an existing water management system in agricultural land on more **than 50 % of the STU**.
WM2	Code for the type of existing water management system.

- Obviously, **WM1** and **WM2** are inter-dependant. For example, if WM1 = 2 (no water management system) then WM2 can only have value 2 (no water management system). As another example, WM1 = 3 (a water management system exists to alleviate waterlogging (drainage)) is clearly not compatible with WM2 = 9 (flood irrigation).

- The list of authorised codes and their corresponding meaning is given in the following tables for attributes **WM1** and **WM2**:

WM1 codes and their meaning	
0	No information
1	Not applicable (no agriculture)
2	No water management system
3	A water management system exists to alleviate waterlogging (drainage)
4	A water management system exists to alleviate drought stress (irrigation)
5	A water management system exists to alleviate salinity (drainage)
6	A water management system exists to alleviate both waterlogging and drought stress
7	A water management system exists to alleviate both waterlogging and salinity

WM2 codes and their meaning	
0	No information
1	Not applicable (no agriculture)
2	No water management system
3	Pumping
4	Ditches
5	Dainage pipe network
6	Mole drainage
7	Deep loosening (subsoiling)
8	Furrow irrigation
9	Flood irrigation (system of irrigation by controlled flooding as for rice)
10	Overhead sprinkler (system of irrigation by sprinkling)
11	Drip irrigation

Description of the CONFIDENCE LEVEL of the STU

- The **CFL** attribute provides an overall estimation of the quality of the information describing the STU considering all other attributes recorded by the contributing expert.
  It has been included here because, at the onset of the work on the 1:1,000,000 map, the information for the database often came from different sources, gathered at different periods. The scale of the surveys and the methods used often differed. Evaluation of the overall data quality must be based on the characteristics of the original map or maps, the age of the survey, the number of profiles described and analysed to characterise the STU, etc..
  The confidence level for the description of the STU attributes is best given by the soil scientist who compiled the map or by the map co-ordinator.
- The list of authorised codes and their corresponding meaning is given in the following table for attribute **CFL**:

CFL codes and their meaning	
0	No information
H	High confidence in the STU description
M	Medium confidence in the STU description
L	Low confidence in the STU description
V	Very low confidence in the STU description because some interpretation was made by the co-ordinator

2.6 EXCEL® FILE SMU-STU.XLS

To help contributors in supplying data for the Soil Geographical Database, a file in Excel® format was developed. It presents, on only one sheet, all the attributes that must be filled in for SMUs and STUs description. The attributes for SMU or STU correspond to those of the INFO® tables STU.ORG and STU. The codes used for each attribute of the Excel® file are the same as the codes of the corresponding variable of the INFO® tables STU.ORG or STU.

A sample of a SMU and STU description in the Excel® file is shown in the following pages. It contains examples taken from parts of the existing database, describing a few SMUs and their STU components. The examples presented have been selected in different countries to illustrate what a completed file actually looks like.

Table 1: example of a SMU-STU description in the Excel® file SMU-STU.XLS

COUNTRY	SMU	STU	PCAREA	WRB-GRP	WRB-ADJ	WRB-SPE	FAO90-MG	FAO90-UNI	FAO90-SUB	SLOPE-DOM	SLOPE-SEC	ZMIN	ZMAX	PAR-MAT-DOM	PAR-MAT-SEC	USE-DOM	USE-SEC	AGLIM1	AGLIM2	TEXT-SRF-DOM	TEXT-SRF-SEC	TEXT-SUB-DOM	TEXT-SUB-SEC	TEXT-DEP-CHG	ROO	IL	WR	WM1	WM2	CFL
FR	330296	331001	40	LP	dy		LP	d		1	1	800	2600	4240	3400	1	5	3	2	2	2	0	0	5	3	1	1	2	0	H
		331002	40	LP	um		LP	u		1	1	800	2600	4240	3400	1	5	3	4	2	2	0	0	5	3	1	1	2	0	H
		331003	10	CM	dy		CM	d		1	1	800	2600	4240	3400	1	5	2	2	2	2	0	0	5	1	1	1	2	0	M
		331004	5	CM	eu		CM	e		2	2	800	2600	4240	3400	3	1	2	2	2	2	0	0	5	1	1	2	2	0	M
		331005	5	LV	ha		LV	h		1	1	800	2600	4240	3400	3	1	2	2	2	2	3	3	2	1	1	1	2	0	M
FR	330297	331006	60	CL	ha	m	CL	h		1	1	300	1000	2111	2122	8	0	2	2	3	3	0	0	5	1	1	1	2	0	L
		331007	20	CM	eu		CM	e	v	2	1	300	1000	2111	2122	8	0	1	1	3	3	4	4	2	1	1	1	2	0	L
		331008	10	LP	rz		LP	k		2	2	300	1000	2111	2122	8	0	3	2	2	2	0	0	5	3	1	1	2	0	L
		331009	10	LV	cr		LV	x		1	1	300	1000	2111	2122	8	0	1	1	3	3	0	0	5	1	1	1	2	0	L
DE	490031	490028	50	CM	vr		CM	v		2	2	200	1500	2140	1211	3	5	1	2	4	4	2	1	3	1	1	1	2	0	H
		490029	30	CM	eu		CM	e		2	2	200	1500	2140	1211	3	5	1	2	4	3	3	4	3	1	2	2	3	5	H
		490030	10	LV	gl		LV	g		3	2	200	1500	5610	2140	5	3	20	20	2	2	3	2	2	3	2	3	3	5	M
		490031	10	GL	eu	s	GY	e		2	2	200	1500	2140	1211	3	5	1	1	2	3	3	2	3	1	3	4	2	0	M
IT	390159	390509	80	LP	dy		LP	d		3	4	1000	3000	4220	4240	1	5	3	1	2	0	0	0	5	3	1	1	2	0	M
		390510	10	LP	ha		LP	d		3	4	1000	3000	4240	4240	1	5	3	1	2	0	0	0	5	4	1	1	2	0	M
		390511	10	CM	dy		CM	d		2	3	1000	3000	4220	4240	1	5	3	1	2	4	0	0	5	2	3	3	2	0	M

PART 3: THE SOIL PROFILE DATABASE

In order to enhance information about soils, the 1:1,000,000-scale Soil Geographical Database has been improved with the addition of a Soil Profile Database (Madsen and Jones, 1995a). This database contains soil profile characterisations with physical and chemical analyses. For each dominant Soil Typological Unit (STU), and if possible, for all of them, a representative soil profile with its analytical data is selected by the contributing experts in their own country. Difficulties were encountered during the attempt to harmonise those data across countries. Thus, the decision was made to have two different kinds of profiles, characterised to a depth of 2 m, for each STU being recorded: measured soil profiles and estimated soil profiles (see Madsen and Jones, 1995b).

The measured soil profiles correspond to a set of data taken directly from **georeferenced** soil profiles, described in the field, sampled, and analysed in the laboratory. Data for those profiles are recorded in the "Measured profiles" table.

The estimated profile description corresponds to a **non-georeferenced** soil profile, based on an average of various observations and expert knowledge. Data for those profiles are recorded in the "Estimated profiles" table.

For measured profiles, a code indicates which analytical methods were used, and missing values are permitted.

For estimated profiles, the analytical methods are selected to allow comparisons of properties across countries, and all properties must be fully described, using expert estimates if needed.

Examples of "Measured profiles" table and "Estimated profiles" table are given at the end of each section presenting respectively measured and estimated soil profile attributes. They are provided on separate Excel® files to help contributors in filling in these tables.

3.1 "MEASURED PROFILES" TABLE: MEASURED DATA FOR SOIL PROFILES.

Measured data for soil profiles are recorded in "Measured profiles" table. These data represent soil profile measurements and descriptions in the field, as well as analyses of soil samples in the laboratory. Ideally, the soil profile that best describes the STU and that is geographically located within the SMU must be chosen. But, when it is difficult to find it, another georeferenced measured soil profile should be selected to illustrate the central concept that defines the STU, even if it is not geographically located within the SMU. This profile should correspond to the typical pedon representative of the STU.

3.1.1 Instructions for filling out "Measured profiles" table

- The following table provides a summary description of the data contained in the "Measured profiles" table. The first part of the table contains attributes characterising the profile. The second part of the table lists the attributes used to describe the individual horizons forming the soil profile.
- Frequently, two attributes (columns) have to be filled in to describe one soil characteristic. This enables to record both the value for the measured attribute and the measurement or analytical method used to obtain this measured value. The measurement value is recorded in the first attribute labelled with an abbreviation for the variable, i.e. **BD** for bulk density, and the measurement method is recorded in the second attribute relative to the measured variable, with a similar label but followed by the suffix **M**, i.e. **BD-M**, to indicate the method used to determine the bulk density.

NAME	DESCRIPTION	TYPE	SIZE
COUNTRY	ISO country code	Character	2
STU	Soil Typological Unit (STU) identifying Number.	Integer number	7
WRB-GRP	Soil Group code of the STU taken from the World Reference Base (WRB) for Soil Resources.	Character string	2
WRB-ADJ	Soil Adjective code of the STU taken from the World Reference Base (WRB) for Soil Resources.	Character string	2
WRB-SPE	Complementary code of the STU taken from the World Reference Base (WRB) for Soil Resources.	Character string	3

FAO90-MG	Soil Major Group code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	2
FAO90-UNI	Soil Unit code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	3
FAO90-SUB	Soil Sub-Unit code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend	Character string	4
LAT	Latitude of the soil profile in decimal degrees	real number	10
LONG	Longitude of the soil profile in decimal degrees	real number	10
ELEV	Elevation above Mean Sea Level	integer	4
PAR-MAT	Code for Parent Material of the Soil profile.	Integer number	4
TWT	Type of a Water Table	Integer number	1
HGWL	Highest Groundwater table Level	real number	3
LGWL	Lowest Groundwater table Level	real number	3
USE	Code for Land Use of the soil profile	Integer number	2
ROO	Root Depth of the soil profile	real number	3
ROC	Rock Depth of the soil profile	real number	3
OBS	Obstacle Depth of the soil profile	real number	3
HOR	Horizon Name in the FAO nomenclature of soil horizon	Character string	6
D-HOR	Depth of the horizon lower boundary	real number	3
STRUCT	Structure in the FAO nomenclature of soil horizon	Integer number	2
M-COL	Moist soil colour (Munsell colour charts) of soil horizon	Character string	8
D-COL	Dry soil colour (Munsell colour charts) of soil horizon	Character string	8
CLAY	Percent clay fraction of soil horizon	Integer number	4
CLAY-ESD	*Particle size upper limit for clay (µm)*	*Integer number*	*1*
SILT	silt fraction of soil horizon	real number	4
SILT-ESD	*Particle size upper limit for silt (µm)*	*Integer number*	*3*
SAND-1	Percent fine sand of soil horizon	real number	4
SAND-1-ESD	*Particle size upper limit for fine sand (µm)*	*Integer number*	*3*
SAND-2	Percent medium sand of soil horizon	real number	4
SAND-2-ESD	*Particle size upper limit for medium sand (µm)*	*Integer number*	*3*
SAND-3	Percent coarse sand of soil horizon	real number	4
SAND-3-ESD	*Particle size upper limit for coarse sand (µm)*	*Integer number*	*4*
GRAVEL	Stones and Gravel content in the horizon (%)	real number	4
OC	Organic Carbon content in the horizon (%)	real number	4
OC-M	*Measurement method for organic carbon*	*real number*	*2*
N	Total Nitrogen of soil horizon	real number	4
N-M	*Measurement method for Total Nitrogen*	*real number*	*2*
TCA	Total Calcium Carbonate equivalent $CaCO_3$ of soil horizon	real number	4
TCA-M	*Measurement method for Total $CaCO_3$ equivalent*	*real number*	*2*
GYP	Gypsum ($CaSO_42H_2O$) content of soil horizon	real number	4
GYP-M	*Measurement method for $CaSO_42H_2O$ content*	*real number*	*2*
PH	Soil horizon pH of soil horizon	real number	4
PH-M	*Measurement method for the pH*	*real number*	*2*
EC	Electrical Conductivity	Integer number	6
EC-M	*Measurement method for Electrical Conductivity*	*real number*	*2*
SAR	Sodium Adsorption Ratio of soil horizon	Integer number	6
ESP	Exchangeable Sodium Percentage of soil horizon	real number	6
EXCH-CA	Exchangeable Calcium of soil horizon	real number	6
EXCH-CA-M	*Measurement method for exchangeable Calcium*	*real number*	*2*
EXCH-MG	Exchangeable Magnesium of soil horizon	real number	6
EXCH-MG-M	*Measurement method for exchangeable Magnesium*	*real number*	*2*
EXCH-K	Exchangeable Potassium of soil horizon	real number	6
EXCH-K-M	*Measurement method for exchangeable Potassium*	*real number*	*2*
EXCH-NA	Exchangeable Sodium of soil horizon	real number	6
EXCH-NA-M	*Measurement method for exchangeable Sodium*	*real number*	*2*
CEC	Cation Exchange Capacity of soil horizon	real number	5
CEC-M	*Measurement method for Cation Exchange Capacity*	*real number*	*2*
BS	Base Saturation of soil horizon	real number	3
BS-M	*Measurement method for Base Saturation*	*real number*	*2*

WR-1	Soil water retention at WR-1-M (volume percent water) of soil horizon	integer number	3
WR-1-M	*Suction value for measurement of WR-1 (kPa)*	*real number*	*2*
WR-2	Soil water retention at WR-2-M (volume percent water) of soil horizon	integer number	3
WR-2-M	*Suction value for measurement of WR-2 (kPa)*	*real number*	*2*
WR-3	Soil water retention at WR-3-M (volume percent water) of soil horizon	integer number	3
WR-3-M	*Suction value for measurement of WR-3 (kPa)*	*real number*	*2*
WR-4	Soil water retention at WR-4-M (volume percent water) of soil horizon	integer number	3
WR-4-M	*Suction value for measurement of WR-4 (kPa)*	*real number*	*2*
WR-FC	Soil Water Retention of soil horizon at Field Capacity of soil horizon	integer number	3
WR-FC-M	*Suction measurement value for WR-FC (kPa)*	*real number*	*2*
POR	Total Porosity of soil horizon	integer number	3
POR-M	*Measurement method for Total Porosity*	*real number*	*2*
BD	Bulk Density of soil horizon	real number	4
BD-M	*Measurement method for Bulk Density*	*real number*	*2*

- The codes to define the type, method and/or unit of measurement are numbered 0 through 30. For example, for **CEC**, the value “21” for attribute **CEC-M** means the CEC measurement was made using the extraction method with 1N NH_4AOc at pH 7.0 (see Madsen and Jones (1995c) and the list of codes below and their meaning for measurement methods for each variable).
- Any additional codes for other analytical methods can be introduced and numbered from 31 onwards. It will not matter if those codes appear out of numerical sequence for a given measured attribute. These will be included in a relational table that can be incremented in the future.
- Both attributes concerning a soil variable must be filled in. In the case when no value will be available for a soil variable, then a negative value must be entered in both attributes using the following codes:

-9 : Missing value, for unknown reason
-8 : Not applicable
-7 : No analysis has been carried out. The code –7 must be entered when the information is truly lacking

Remark:
In some particular cases, the code is meaningless for some records: for example, the attributes for texture or exchangeable bases do not apply to a R horizon. In these instances, by convention, the code **–8** has to be used.

Description of COUNTRY of the Profile

- The code for the country (**COUNTRY**) in which the profile is located must be selected in the following international two character ISO country code list.

List of ISO COUNTRY codes	
AL	ALBANIA
DZ	ALGERIA
AT	AUSTRIA
BY	BELARUS
BE	BELGIUM
BA	BOSNIA HERZEGOVINA
BG	BULGARIA
HR	CROATIA
CZ	CZECH REPUBLIC
CY	CYPRUS
DK	DENMARK
EG	EGYPT
EE	ESTONIA

FI	FINLAND
FR	FRANCE
MK	F.Y.R.O.M. (Former Yugoslav Republic of Macedonia)
DE	GERMANY
GR	GREECE
HU	HUNGARY
IS	ICELAND
IE	IRISH REPUBLIC
IL	ISRAEL
IT	ITALY
JO	JORDAN
LB	LEBANON
LV	LATVIA
LT	LITHUANIA
LU	LUXEMBOURG
LY	LYBIA
MT	MALTA
MD	MOLDOVA
MA	MOROCCO
NL	NETHERLANDS
NO	NORWAY
PS	PALESTINE
PL	POLAND
PT	PORTUGAL
RO	ROMANIA
RU	RUSSIA
SK	SLOVAK REPUBLIC
SI	SLOVENIA
ES	SPAIN
SE	SWEDEN
SY	SYRIA
CH	SWITZERLAND
TN	TUNISIA
TR	TURKEY
UA	UKRAINE
UK	UNITED KINGDOM
YU	YUGOSLAVIA

Description of STU IDENTIFIER of the Profile

- The **STU** attribute contains the identifying **number** linking the soil profile to its corresponding STU. It must correspond to the STU identifier used in the STU table to identify the STU.
- The **STU** identifier is **mandatory**.
- See *section 2.4, on page11* for instructions regarding how to fill STU attribute information.

Description of SOIL NAME of the Profile

- The name of the soil type is indicated following the WRB and **FAO90** nomenclatures.
- For coding attributes **WRB-GRP**, **WRB-ADJ**, **WRB-SPE**, **FAO90-MG**, **FAO90-UNI** and **FAO90-SUB**, see coding scheme *section 2.5, on pages 14 to 19.*

Description of LOCATION of the Profile

- Geographical location is described within the **LAT**, **LONG** and **ELEV** attributes:

LAT	Latitude of the soil profile
LONG	Longitude of the soil profile
ELEV	Elevation of the soil profile

- Latitude (**LAT**) and Longitude (**LONG**) should be recorded using decimal degrees in relation to the Greenwich Meridian and the Equator.
- Elevation (**ELEV**) should be recorded in metres above Mean Sea Level.

Description of PARENT MATERIAL of the Profile

- Codes for the Parent Material (**PAR-MAT**) of the measured soil profile are those used in the STU table.
- Use the parent materials list given in the first part of this Instructions Guide to find the appropriate 4-digit code and providing the highest possible level of detail. See *section 2.5, on page 20.*

Description of WATER TABLE TYPE of the Profile

- The list of authorised codes and their corresponding meaning is given in the following table for attribute **TWT**:

TWT codes and their meaning	
0	no water table
1	Perched water table
2	Permanent water table

Description of GROUNDWATER TABLE LEVELS of the Profile

- The groundwater table level within or below a soil profile often varies in time. Therefore, the following two attributes are used to record the different groundwater table levels:

HGWL	Code for the mean highest Groundwater table Level
LGWL	Code for the mean lowest Groundwater table Level

- The recorded mean highest (**HGWL**) and mean lowest (**LGWL**) permanent or perched groundwater table level should be the average level for at least the past 10 years.
- Generally such information is lacking and so these values need generally to be estimated or guessed by expert.
- The following table gives the different Groundwater table level classes to be used:

HGWL and LGWL codes and their meaning	
0	No groundwater table
1	Groundwater table between 0 -50 cm
2	Groundwater table between 50 - 100 cm
3	Groundwater table between 100 - 150 cm
4	Groundwater table between 150 - 200 cm
5	Groundwater table between below 200 cm

- For example, if the mean groundwater table level is estimated to 70 cm in winter and 190 cm in summer the **HGWL** and **LGWL** must be filled in as:
  HGWL: Highest groundwater table level: 2
  LGWL: Lowest groundwater table level: 4

Description of LAND USE of the Profile

- The attribute **USE** stores the land use of the soil profile using the coding list given for the STU land use description. See *section 2.5., on page 24*.

Description of DEPTH of the Profile

- The depth of the soil is defined with 3 attributes:

ROO	Depth of soil available for rooting of the soil profile
ROC	Depth to rock of the soil profile
OBS	Depth to another obstacle within the soil profile

- Depth must be given in cm.
- The depth of soil available for rooting should be recorded under **ROO** with a maximum value of 200 cm.
- Depth to the underlying bedrock should be recorded under **ROC.**
- Depth to any other limiting horizon, such as a petrocalcic horizon, should be recorded under **OBS.**

Description of NAME for each Horizon of the Profile

- Each horizon of the soil profile must be named according to the FAO system.
- The name of each horizon is recorded in the attribute **HOR.**
- Please try to select your benchmark soils to avoid having unnecessary subdivision of the main horizons and have as few horizons as possible.

Description of DEPTH for each Horizon of the Profile

- The soil horizon Depth (**D-HOR)** is the depth of the lower boundary of the horizon.
- The maximum depth of description required for the soil profile is 2 metres. Hence, the deepest horizon will be considered to a depth of 2 metres.
- Depth is given in centimetres. The range of authorised values for attribute **D-HOR** is any integer number (without decimal) in interval [0, 200].

Description of STRUCTURE for each Horizon of the Profile

- The type of structure (**STRUCT**) is described following the FAO nomenclature (1986).
- Do not describe size or stability but use the numeric code for the structure class.
- The following list of authorised codes and their corresponding meaning is given below:

STRUCT codes and their meaning	
1	platy
2	prismatic
3	columnar
4	angular blocky
5	subangular blocky
6	granular
7	crumb
8	massive
9	single
10	wedge shaped

Description of SOIL COLOUR for each Horizon of the Profile

M-COL Moist soil colour (Munsell soil colour charts)
D-COL Dry soil colour (Munsell soil colour charts)

- The Soil Colour is given using the Munsell notation: Hue, Value, Chroma, for moist soil **(M-COL)** and dry soil **(D-COL).**
- To soil colour, replace the / symbol in the Munsell code by the – symbol like in these examples: 10YR3/4 should be written 10YR3-4, 10YR3.5/4 should be written 10YR3.5-4.
- Examples of colour notation are presented in the illustrative tables at the end of this section.

Description of TEXTURE for each Horizon of the Profile

- Texture of the fine earth in the soil horizon is divided into five classes recorded by five attributes.
- Values are entered in the **CLAY**, **SILT**, **SAND-1, SAND-2** and **SAND-3** attributes, as percent of the fine earth fraction, with one decimal.
- Textural data is sometimes divided in non standard classes in some of the contributing countries. For example, the boundary between clay and silt may have been set at 1 µm in some countries. In order to record these data correctly, the upper limit (in µm) of the range for a given particle-size class (to the nearest integer) should be recorded into the appropriate attribute **ESD**. For example, if the upper limit for clay is 2 µm, then the attribute **CLAY-ESD** will record the value 2.

Description of STONES and GRAVEL CONTENT for each Horizon of the Profile

- Estimation of the percentage of Stones and Gravel (**GRAVEL**) in the soil horizon.
- Use the following codes to record the amount of Stones and Gravel for each horizon:

GRAVEL codes and their meaning	
0	No stones or gravel
1	Very few (< 5 **%** by volume)
2	few (5 - 15 **%** by volume)
3	frequent or many (15 - 40 **%** by volume)
4	very frequent, very many (40 – 80 % by volume)
5	dominant or skeletal (> 80 % by volume)

- This attribute is not intended for the description of the mineralogy, particle size or weathering status.

Description of ORGANIC CARBON CONTENT for each Horizon of the Profile

- The Organic Carbon Content (**OC**) is estimated in g/100g of dry fine earth.
- It is recorded, with one decimal place (for example 3.8 %), in the attribute **OC**.
- Under **OC-M**, the method used to measure organic carbon is recorded with the following codes:

OC-M codes and their meaning	
1	Walkley-Black method
2	Leco Method Tabatabai and Bremner (1970)
3	Other (specify on separate sheet)

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of TOTAL NITROGEN for each Horizon of the Profile

- The Total Nitrogen (**N**) is recorded, in percentage, to one decimal place.

- Under **N-M**, the method used to obtain **N** is recorded with the following codes:

N-M codes and their meaning	
4	Wet digestion (Kjeldahl method) (%)
5	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of TOTAL CALCIUM CARBONATE CONTENT for each Horizon of the Profile

- The Total Calcium Carbonate $CaCO_3$ (**TCA**) is expressed in % of the fine earth fraction.
- It should be noted to the nearest integer (no decimals).
- Under **TCA-M**, the method is recorded with one of the following codes:

TCA-M codes and their meaning	
6	Calcimeter method (%) [measures CO_2 emitted]
7	Other method

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of GYPSUM CONTENT for each Horizon of the Profile

- The Gypsum ($CaSO_4.2H_2O$) content (**GYP**) is expressed in % of the fine earth.
- The **GYP** attribute value should be given to the nearest integer.
- Under **GYP-M** the method used to measure gypsum contents is recorded with the following codes:

GYP-M codes and their meaning	
8	For soils with small quantities of gypsum: by water extraction (USDA Handbook N°60, Diagnosis and Improvement of Saline and Alkaline Soils, 1954)
9	For highly gypsiferous soils: by loss of crystallisation water between 40°C and 110°C.
10	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of ACIDITY for each Horizon of the Profile

- The pH values (**PH**) should be given by any real number to one decimal place.
- Under **PH-M**, the analytical method is recorded using the following codes:

PH-M codes and their meaning	
11	1:1 water (H_2O)
12	1:2.5 water (H_2O)
13	1:.2.5 0.01 M Calcium Chloride ($CaCl_2$)
14	1:2.5 1M Potassium Chloride (KCl)
15	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of ELECTRICAL CONDUCTIVITY for each Horizon of the Profile

- **EC** is measured in $dS.m^{-1}$ at 25 d°C.
- Under **EC-M** the method is recorded with the following codes:

EC-M codes and their meaning	
17	In extract from sample saturated in water
18	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of SODIUM ADSORPTION RATIO for each Horizon of the Profile

- Sodium adsorption ratio (**SAR**) should be recorded and rounded to the nearest integer.
- In humid areas, SAR is usually less than 4. Unless data for these areas indicate otherwise, enter "**<4**".
- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Remark: Only one of these parameters, **SAR** or **ESP** (see below), needs to be recorded.

Description of EXCHANGEABLE SODIUM PERCENTAGE for each Horizon of the Profile

- The Exchangeable Sodium percentage (**ESP**) is expressed as a percentage of the Cation Exchange Capacity (**CEC**). The value recorded should be rounded to the nearest integer.
- In humid areas, **ESP** is normally less than 15 % and should be recorded as **"<15"**

Remark: Only one of these parameters, **SAR** (see above) or **ESP**, needs to be recorded.

Description of EXCHANGEABLE BASES for each Horizon of the Profile

- Values for Exchangeable Bases Ca, Mg, K, Na, (**EXCH-CA, EXCH-MG, EXCH-K, EXCH-NA**) should be noted to two decimal places.
- Under **EXCH-CA-M, EXCH-MG-M, EXCH-K-M, EXCH-NA-M**, the method to measure exchangeable bases is recorded with the following codes:

EXCH-CA-M, EXCH-MG-M, EXCH-K-M, EXCH-NA-M codes and their meaning	
19	Neutral Ammonium Acetate (NH_4AOc) extract, cmol+/kg
20	Other Method

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of CATION EXCHANGE CAPACITY for each Horizon of the Profile

- The Cation Exchange Capacity (**CEC**) is noted in $cmol^+/kg$.
- Values are given to one decimal place.
- Under **CEC-M**, the analytical method is recorded with the following codes:

CEC-M codes and their meaning	
21	Distillation method ($cmol^+/kg$)
22	Exchangeable Bases Ca + Mg + K + Na + Exchange Acidity
23	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of BASE SATURATION for each Horizon of the Profile

- Base saturation (**BS**) is calculated as the percentage of the CEC taken up by exchangeable bases.
- BS measurement are recorded to the nearest integer.
- Under **BS-M**, the analytical method is recorded with the following codes:

BS-M codes and their meaning	
24	(Exch. Ca + Mg + K + Na / CEC) x 100
25	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of SOIL WATER RETENTION for each Horizon of the Profile

- Soil Water Retention (**WR**) is the volume percent of water in the soil horizons.
- Because different suction measurement levels are used for measuring soil water retention, measurements for water contents (**WR**) at **5 suctions** levels **WR-1, WR-2, WR-3, WR-4** and **WR-FC** are requested.
- **WR-FC** is the water content at Field Capacity.
- Values for water retention measurements must be rounded to the nearest integer.
- The suction measurement value in kPa used will be recorded in the **WR-1-M, WR-2-M, WR-3-M, WR-4-M** and **WR-FC-M**. *For example,* **WR-1-M** = 5 kPa; **WR-2-M** = 10 kPa; **WR-3-M** = 400 kPa; **WR-4-M** = 1500 kPa.
- However, with at least five measurements, a soil water suction curve can be estimated. Estimates at intermediate suctions values can then be made from the curve.

Description of TOTAL POROSITY for each Horizon of the Profile

- Total Porosity (**POR**) is given in %, to the nearest integer.
- Under **POR-M**, the determination method is recorded with the following codes:

POR-M codes and their meaning	
26	(I-DB/DP) %, (DP is particle density: 2.55 – 2.65g/cm^3)
27	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

Description of BULK DENSITY for each Horizon of the Profile

- The bulk density (**BD**) is noted in g/cm^3.
- BD values are recorded to two decimal places.
- Under **BD-M**, the determination method is indicated using the following codes:

BD-M codes and their meaning	
28	Soil core in lab., g/cm^3
29	Wet measurement in the field, g/cm^3
30	Other

- When no data is available, use coding –9; -8 or –7. See *on page* 33.

3.1.2 Examples of measured soil profile descriptions (Excel® file measprof.xls)

COUNTRY	STU	WRB-GRP	WRB-ADJ	WRB-SPE	FAO90-MG	FAO90-UNI	FAO90-SUB	LAT	LONG	ELEV	PAR-MAT	TWT	HGWL	LGWL	USE	ROO	ROC	OBS	HOR	D-HOR	STRUCT	M-COL	D-COL
FR	330179	CM	ca		CM	c	v	49°02'52"	6°23'58"	250	2140	0	0	0	3	80	-8	-8	Ap	20	4	7.5YR3-3	-9
																			Bw	80	4	10YR5-6	-9
																			C	120	2	10YR6-4	-9
FR	330233	LV	dy		PD	d	g	48°01'18"	-2°07'07"	153	1320	1	1	5	5	60	100	-8	Ah	12	1	10YR5-2	-9
																			Eg	30	8	10YR6-3	-9
																			E/Bg	50	8	10YR6-3	-9
																			Btg	75	4	7.5YR7-0	-9
																			Bt/Cg	>75	4	10YR7-2	-9
FR	330071	LP	dy		LP	d		47°30'10"	-3°07'47"	27	3110	0	0	0	4	53	53	-8	Ah1	5	7	10YR3-2	-9
																			Ah2	23	5	10YR3-3	-9
																			AC	46	5	10YR6-4	-9
																			C	53	9	10YR7-4	-9
																			R	>53	-8	10YR7-4	-9
FR	330243	PZ	ha		PZ	h		48°18'33"	6°59'13"	640	1210	0	0	0	5	60	-8	65	A1	25	6	2.5YR4-2	-9
																			E	60	9	2.5YR4-4	-9
																			Bh	65	9	5YR3-2	-9
																			Bs	95	8	10YR4-6	-9
																			C	120	8	2.5YR5-6	-9

CLAY	*CLAY-ESD*	SILT	*SILT-ESD*	SAND-1	*SAND-1-ESD*	SAND-2	*SAND-2-ESD*	SAND-3	*SAND-3-ESD*	GRAVEL	OC	*OC-M*	N	*N-M*	TCA	*TCA-M*	GYP	*GYP-M*	PH	*PH-M*	EC	*EC-M*	SAR	ESP
53.4	*2*	36.3	*50*	5.6	*200*	3.6	*500*	2.1	*2000*	1	2.2	*1*	0.2	*4*	5	*6*	0		8.0	*12*	0			0
36.4	*2*	47.5	*50*	9.3	*200*	6.8	*500*	0.0	*2000*	1	-7		-7		15	*6*	0		8.1	*12*	0			0
29.9	*2*	46.5	*50*	7.1	*200*	16.5	*500*	0.0	*2000*	1	-7		-7		6	*6*	0		8.2	*12*	0			0
11.7	*2*	74.3	*50*	13.3	*200*	0.7	*500*	0.0	*2000*	0	7.6	*1*	0.1	*4*	0		0		3.9	*12*	0			0
12.2	*2*	73.7	*50*	12.5	*200*	1.6	*500*	0.0	*2000*	0	-7		-7		0		0		4.6	*12*	0			0
27.6	*2*	63.1	*50*	8.1	*200*	1.2	*500*	0.0	*2000*	0	-7		-7		0		0		4.8	*12*	0			0
30.2	*2*	61.2	*50*	6.9	*200*	1.7	*500*	0.0	*2000*	1	-7		-7		0		0		4.9	*12*	0			0
24.9	*2*	57.0	*50*	15.2	*200*	2.9	*500*	0.0	*2000*	4	-7		-7		0		0		5.0	*12*	0			0
19.8	*2*	32.2	*50*	13.5	*200*	28.3	*500*	6.2	*2000*	1	29.9	*1*	1	*4*	0		0		4.9	*12*	0			0
13.4	*2*	33.4	*50*	13.5	*200*	32.4	*500*	7.3	*2000*	1	7.5	*1*	0.4	*4*	0		0		5.0	*12*	0			0
8.8	*2*	31.0	*50*	12.5	*200*	38.1	*500*	9.6	*2000*	3	5.1	*1*	0.2	*4*	0		0		5.0	*12*	0			0
3.2	*2*	15.5	*50*	11.7	*200*	49.2	*500*	20.4	*2000*	4	2.2	*1*	0.1	*4*	0		0		5.1	*12*	0			0
-8		-8		-8		-8		-8		-8	-8		-8		0		0		-8		0			0
3.9	*2*	7.6	*50*	19.9	*200*	60.3	*500*	8.3	*2000*	0	6.5	*1*	0.1	*4*	0		0		3.7	*12*	0			0
1.3	*2*	8.2	*50*	24.3	*200*	59.0	*500*	7.2	*2000*	0	0.9	*1*	0	*4*	0		0		3.8	*12*	0			0
14.6	*2*	9.0	*50*	20.7	*200*	49.3	*500*	6.4	*2000*	1	8.8	*1*	0.2	*4*	0		0		4.0	*12*	0			0
4.8	*2*	9.3	*50*	21.5	*200*	55.2	*500*	9.2	*2000*	2	4.5	*1*	0.1	*4*	0		0		4.5	*12*	0			0
1.2	*2*	7.1	*50*	18.1	*200*	62.4	*500*	11.2	*2000*	3	0.3	*1*	0	*4*	0		0		4.4	*12*	0			0

EXCH-CA	*EXCH-CA-M*	EXCH-MG	*EXCH-MG-M*	EXCH-K	*EXCH-K-M*	EXCH-NA	*EXCH-NA-M*	CEC	*CEC-M*	BS	*BS-M*	WR-1	*WR-1-M*	WR-2	*WR-2-M*	WR-3	*WR-3-M*	WR-4	*WR-4-M*	WR-FC	*WR-FC--M*	POR	*POR-M*	BD	*BD-M*
41.80	*19*	4.10	*19*	1.80	*19*	0.05	*19*	26.5	*21*	100	*24*	46	*1*	42	*10*	33	*100*	27	*1500*	-7		52	26	1.25	28
42.80	*19*	4.10	*19*	0.50	*19*	0.06	*19*	20.4	*21*	100	*24*	36	*1*	33	*10*	23	*100*	18	*1500*	-7		42	26	1.50	28
38.90	*19*	3.90	*19*	0.60	*19*	0.06	*19*	19.3	*21*	100	*24*	35	*1*	30	*10*	20	*100*	15	*1500*	-7		41	26	1.53	28
0.10	*19*	0.12	*19*	0.06	*19*	0.10	*19*	10.2	*21*	4	*24*	38	*1*	33	*10*	20	*100*	14	*1500*	-7		50	26	1.30	28
0.10	*19*	0.04	*19*	0.04	*19*	0.06	*19*	3.8	*21*	6	*24*	40	*1*	32	*10*	22	*100*	13	*1500*	-7		47	26	1.40	28
0.10	*19*	0.31	*19*	0.13	*19*	0.13	*19*	7.6	*21*	10	*24*	43	*1*	40	*10*	26	*100*	18	*1500*	-7		44	26	1.50	28
0.10	*19*	0.90	*19*	0.18	*19*	0.20	*19*	10.2	*21*	13	*24*	41	*1*	39	*10*	30	*100*	18	*1500*	-7		42	26	1.55	28
0.10	*19*	2.00	*19*	0.15	*19*	0.20	*19*	8.8	*21*	27	*24*	-7		-7		-7		17	*1500*	-7		-7		-7	
4.30	*19*	2.10	*19*	0.80	*19*	0.60	*19*	28.9	*21*	27	*24*	-7		-7		-7		-7		-7		-7		-7	
1.30	*19*	0.80	*19*	0.23	*19*	0.30	*19*	19.0	*21*	14	*24*	-7		-7		-7		-7		-7		-7		-7	
1.30	*19*	0.30	*19*	0.11	*19*	0.23	*19*	13.5	*21*	15	*24*	-7		-7		-7		-7		-7		-7		-7	
0.40	*19*	0.20	*19*	0.06	*19*	0.10	*19*	8.8	*21*	8	*24*	-7		-7		-7		-7		-7		-7		-7	
-8		-8		-8		-8		-8		-8		-8		-8		-8		-8		-8		-8		-8	
1.00	*19*	0.40	*19*	0.08	*19*	-7	*19*	12.1	*21*	12	*24*	-7		-7		-7		-7		-7		-7		-7	
0.60	*19*	0.30	*19*	0.03	*19*	-7	*19*	3.1	*21*	30	*24*	-7		-7		-7		-7		-7		-7		-7	
0.60	*19*	0.40	*19*	0.10	*19*	-7	*19*	34.6	*21*	35	*24*	-7		-7		-7		-7		-7		-7		-7	
0.60	*19*	0.50	*19*	0.10	*19*	-7	*19*	15.4	*21*	8	*24*	-7		-7		-7		-7		-7		-7		-7	
0.50	*19*	0.20	*19*	0.06	*19*	-7	*19*	2.8	*21*	26	*24*	-7		-7		-7		-7		-7		-7		-7	

3.2 "ESTIMATED PROFILES" TABLE: ESTIMATED DATA FOR SOIL PROFILES

Data for estimated soil profiles are recorded in "Estimated profiles" table. Ideally, "Estimated profiles" table should be filled in with the data that illustrates best each STU. For each attribute, the data can be an average of the observations made on several measured profiles corresponding to the STU. The data can also correspond to a specific soil profile that has been defined as the one fitting the best to the central concept for that STU. Or, for some attributes, the data can be the result of expert knowledge when the data are missing or information is incomplete. All STUs that have been listed should have a corresponding estimated profile fully characterised in "Estimated profiles" table. This requirement may be waived only if neither the data nor the expert knowledge are available in a given area. In this case, the co-ordinator should at least provide the characteristics of the dominant STU. In other cases also, a STU may represent only a tiny part of the surface area in a SMU and its description may be omitted.

3.2.1 Instructions for filling out "Estimated profiles" table

- The following table provides a summary description of the data contained in "Estimated profiles" table: estimated data for soil profiles. The structure of "Estimated profiles" table is similar to that proposed for "Measured profiles" table, described in *section 3.1,* except for the second column to record a code defining the origin of data.

- The first part of the table contains attributes characterising the profile. The second part of the profile lists the attributes used to describe the individual horizons forming the soil profile.

NAME	DESCRIPTION	TYPE	SIZE
COUNTRY	ISO Country code	Character	2
STU	Soil Typological Unit (STU) identifying number.	Integer number	7
WRB-GRP	Soil Group code of the STU taken from the World Reference Base (WRB) for Soil Resources.	Character string	2
WRB-ADJ	Soil Adjective code of the STU taken from the World Reference Base (WRB) for Soil Resources.	Character string	2
WRB-SPE	Complementary code of the STU taken from the World Reference Base (WRB) for Soil Resources.	Character string	3
FAO90-MG	Soil Major Group code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	2
FAO90-UNI	Soil Unit code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend.	Character string	3
FAO90-SUB	Soil Sub-Unit code of the STU taken from the 1990 FAO-UNESCO Soil Revised Legend	Character string	4
PAR-MAT	Code for Parent Material of the soil profile.	Integer number	4
TWT	Type of a Water Table of the soil profile	Integer number	1
HGWL	Highest Groundwater table Level of the soil profile	real number	3
LGWL	Lowest Groundwater table Level of the soil profile	real number	3
USE	Code for dominant Land Use of the soil profile	Integer number	2
DTC	Dominant Type of Crops of the soil profile	Integer number	2
MERD	Mean Effective Root Depth in cm of the soil profile	real number	3
MTRD	Mean Total Root Depth in cm of the soil profile	real number	3
HOR	Horizon Name in FAO system of the soil profile	Character string	6
HOR-O	*Origin of data for horizon names*	*Integer number*	*1*
D-HOR	Depth of lower horizon boundary	real number	3
D-HOR-O	*Origin of data for horizon depths*	*Integer number*	*1*
STRUCT	Structure in FAO nomenclature of the soil horizon	Integer number	2
STRUCT-O	*Origin of data for horizon structure*	*Integer number*	*1*
M-COL	Moist soil colour of the soil horizon	Charact.+ number	8
D-COL	Dry soil colour of the soil horizon	Charact.+ number	8
COL-O	*Origin of data for soil colour*	*Integer number*	*1*
TEXT-2	Clay fraction < 2 µm of the soil horizon	Integer number	4
TEXT-20	Silt fraction 2 – 20 µm of the soil horizon	real number	4
TEXT-50	Silt fraction 20 – 50 µm of the soil horizon	real number	4
TEXT1-O	*Origin of data for clay and silt fractions*	*Integer number*	*1*
TEXT-200	Sand fraction 50 – 200 µm of the soil horizon	real number	4
TEXT-2000	Sand fraction 200 – 2000 µm of the soil horizon	real number	4
TEXT2-O	*Origin of data for sand fraction 50 – 2000 µm*	*Integer number*	*1*
GRAVEL	Stones and Gravel in % of the soil horizon	real number	4
GRAVEL-O	*Origin of data for stones and gravel in %*	*Integer number*	*1*
OM	Organic Matter in % of the soil horizon	real number	4
OM-O	*Origin of data for organic matter in %*	*Integer number*	*1*
CN	Carbon/Nitrogen Ratio of the soil horizon	real number	2
CN-O	*Origin of data for Carbon/Nitrogen ratio*	*Integer number*	*1*
TCA	Total Calcium Carbonate equivalent $CaCO_3$ of the soil horizon	real number	4
TCA-O	*Origin of data for total Calcium Carbonate equivalent $CaCO_3$*	*Integer number*	*1*
GYP	Gypsum ($CaSO_42H_2O$) content of the soil horizon	real number	4
GYP-O	*Origin of data for Gypsum ($CaSO_42H_2O$) content*	*Integer number*	*1*
PH	pH measured in water of the soil horizon	real number	4
PH-O	*Origin of data for pH measured in water*	*Integer number*	*1*
EC	Electrical Conductivity of the soil horizon	Integer number	6
EC-O	*Origin of data for electrical conductivity*	*Integer number*	*1*

SAR	Sodium Adsorption Ratio of the soil horizon	Integer number	6
SAR-O	*Origin of data for Sodium adsorption ratio*	*Integer number*	*1*
ESP	Exchangeable Sodium Percentage of the soil horizon	real number ?	6
ESP-O	*Origin of data for exchangeable Sodium percentage of the soil horizon*	Integer number	1
EXCH-CA	Exchangeable Calcium of the soil horizon	real number	6
EXCH-MG	Exchangeable Magnesium of the soil horizon	real number	6
EXCH-K	Exchangeable Potassium of the soil horizon	real number	6
EXCH-NA	Exchangeable Sodium of the soil horizon	real number	6
EXCH-CAT-O	*Origin of data for exchangeable cations*	*Integer number*	*1*
CEC	Cation Exchange Capacity of the soil horizon	real number	5
CEC-O	*Origin of data for Cation Exchange Capacity*	*Integer number*	*1*
BS	Base Saturation of the soil horizon	real number	3
BS-O	*Origin of data for Base Saturation*	*Integer number*	*1*
WR-1	Soil Water Retention of soil horizon at 1 kPa of the soil horizon	Integer number	3
WR-10	Soil Water Retention of soil horizon at 10 kPa of the soil horizon	Integer number	3
WR-100	Soil Water Retention of soil horizon at 100 kPa of the soil horizon	Integer number	3
WR-1500	Soil Water Retention of soil horizon at 1500 kPa of the soil horizon	Integer number	3
WR-O	*Origin of data for Soil Water Retention of soil horizon at different suctions*	*Integer number*	1
WR-FC	Soil Water Retention at Field Capacity of the soil horizon	integer number	3
WR-FC-O	*Origin of data for Soil Water Retention at Field Capacity*	*Integer number*	*1*
POR	Total Porosity of the soil horizon	integer number	3
POR-O	*Origin of data for total porosity*	*Integer number*	*1*
BD	Bulk Density of the soil horizon	real number	4
BD-O	*Origin of data for bulk Density*	*Integer number*	*1*

- The estimated soil profile data may come from existing measured profiles or modal ones. For the same estimated profile, some data may come from real analytical values from one or several profiles, or may be from expert judgement. So, **for most attributes describing the soil profile horizons, the origin of data must be given**.
- For the attributes where the origin of the data is required, this origin is recorded in an attribute which name corresponds to the attribute name followed by the suffix **-O**. For example, the attribute **STRUCT** contains the type of soil structure of the horizon. It is followed by the attribute **STRUCT-O** that indicates how the information on soil structure was obtained.
- The following categories for origin of data are suggested:

ORIGIN OF DATA codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

- All the attributes describing the soil profile and its horizon must be filled in for estimated profiles, using real measured values, average of measured values or estimated values. But for some very rare cases, if no value will be available for a soil variable, then a negative value must be entered using the following codes:

-9 : Missing value, for no determined reason
-8 : Not applicable

Remark:
In some cases, the code is meaningless for some records: for example, the attributes for texture or exchangeable bases do not apply to an R horizon (rock). In these instances, by convention, the code **–8** has to be used.

Description of COUNTRY of the Profile

- The code for the country (**COUNTRY**) must be selected in the following international two character ISO country code list.
- See the list of country codes *in section 3.1.1., on page 33.*

Description of STU IDENTIFIER of the Profile

- The **STU** attribute contains the identifying **number** linking the soil profile to its corresponding STU. It must correspond to the STU identifier used in the STU table to identify the STU.
- The STU identifier is **mandatory**.
- See *section 2.4., on page 11* for instructions on how to enter STU values.

Description of SOIL NAME of the Profile

- The name of the soil type is indicated following the WRB and FAO90 nomenclature.
- For coding attributes **WRB-GRP**, **WRB-ADJ**, **WRB-SPE**, **FAO90-MG**, **FAO90-UNI** and **FAO90-SUB**, see coding scheme *section 2.5., pages14 to 19.*

Description of PARENT MATERIAL of the Profile

- Codes for Parent Material (**PAR-MAT**) of the estimated soil profile are those used in the STU table.
- Use the parent materials list given in the first part of this Instructions Guide to find the appropriate 4-digit code and providing the highest possible level of detail. See *section 2.5, on page 20.*

Description of WATER TABLE TYPE of the Profile

- The attribute **TWT** stores the type of water table of the soil profile.
- The list of authorised codes and their corresponding meaning are those used for Measured profiles. See *section 3.1.1., on page 35.*

Description of GROUNDWATER TABLE LEVELS for the Profile

- The attributes **HGWL** and **LGWL** stores the mean highest and mean lowest groundwater table levels of the soil profile.
- The list of the authorised codes and their corresponding meaning are those used for Measured profiles. See *Section 3.1.1., on page 35.*

Description of LAND USE of the Profile

- The attribute **USE** stores the land use of the soil profile using the coding list given for the STU land use description. See *section 2.5., on page 24.*
- It is obvious that for estimated profiles, the land use of the profile must corresponds to the dominant land use of its corresponding STU.

Description of ROOT DEPTH of the Profile

- The following three attributes are used for description:

DTC	Dominant Type of crop
MERD	Mean Effective Root Depth
MTRD	Mean Total Root Depth

- Depths are given for the Dominant Type of crops as indicated by attribute **DTC**.
- The list of authorised codes and their corresponding meaning is given in the following table for **DTC** data:

DTC codes and their meaning	
1	Winter sown cereals
2	Spring sown cereals
3	Short grass
4	Beets
5	Olives
6	Maize
7	Cotton
8	Coniferous forest
9	Deciduous forest
10	Others
-1	No crop

- Two depths are indicated: the mean effective root depth (**MERD**) and the mean total root depth (**MTRD**).
- The mean effective rooting depth (**MERD**) is defined as the soil depth in which the plant available water (difference between field capacity and permanent wilting point) is equal to the amount of soil water that can be used by the plants until wilting occurs due to lack of water.
- The mean total root depth (**MTRD**) is self evident. Depths are given for different types of vegetation (listed in the coding scheme below) which may grow on the soil type. If no crop is growing enter '-1'. In arid areas, where there is usually little or no leaching, effective rooting depth has no significance and should not be recorded.
- **MERD** and **MTRD** depths must be given in cm.
- The maximum value for root depths is **200 cm**.
- The domain of authorised values for attributes **MERD** and **MTRD** is any real number in interval [0, 200].

Description of NAME for each Horizon of the Profile

- Each horizon of the soil profile must be named according to the FAO system.
- The name of each horizon is recorded in the attribute **HOR.**
- Please try to select your benchmark soils to avoid having unnecessary subdivision of the main horizons and have as few horizons as possible.
- The following categories for **HOR-O** are:

HOR-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of DEPTH for each Horizon of the Profile

- For description of **D-HOR** attribute See Measured Soil Profile *section 3.1.1., on page 36.*
- The following categories for **D-HOR-O** are:

D-HOR-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of STRUCTURE for each Horizon of the Profile

- For description of **STRUCT** attribute, See Measured Soil Profile *in section 3.1.1., on page 36.*
- The following categories for **STRUCT-O** are:

STRUCT-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of SOIL COLOUR for each Horizon of the Profile

M-COL	Moist soil colour (Munsell soil colour charts)
D-COL	Dry soil colour (Munsell soil colour charts)

- The Soil Colour is given using the Munsell notation: Hue, Value, Chroma, for moist soil **(M-COL)** and dry soil **(D-COL).**
- Integers only are acceptable to characterise value and chroma. However, colour should ordinarily be expressed to the nearest chip. For example, 10YR3/4 should be written 10YR34. The colour 10YR3.5/4 should be simplified to 10YR3/4 or 10YR4/4.
- The origin of data for **M-COL** and **D-COL** are stored in one attribute **COL-O**.
- The following categories for **COL-O** are:

COL-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of TEXTURE for each Horizon of the Profile

- Texture of the fine earth in the soil horizon is divided into five classes recorded by five attributes.
- Values are given in **TEXT-2**, **TEXT-20, TEXT-50, TEXT-200, TEXT-2000** as percent of the fine earth fraction.
- These attributes correspond to the five classes of particle sizes, as defined below:

TEXT-2	Clay fraction: < 2µm
TEXT-20	Silt fraction: 2 – 20µm
TEXT-50	Silt fraction: 20 - 50µm
TEXT-200	Fine sand fraction : 50 – 200µm
TEXT-2000	Coarse sand fraction: 200 – 2000µm

- The % will be estimated to the nearest integer, i.e., without decimals. For example: clay = 28 %, not 27.8 %. The sum of all textural classes should add up to100 %.
- The origin of data for texture is given in two attributes: **TEXT1-O** for clay and silt fractions, **TEXT2-O** for sand fractions.

- The following categories for **TEXT1-O** and **TEXT2-O** are:

TEXT1-O and TEXT2-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of STONES and GRAVEL CONTENT for each Horizon of the Profile

- Estimation of the percentage of Stones and Gravel (**GRAVEL**) in the soil horizon.
- To record the amount of Stones + Gravel for each horizon, See *section 3.1.1., on page 37*.
- The following categories for **GRAVEL-O** are:

GRAVEL-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of ORGANIC MATTER CONTENT for each Horizon of the Profile

- Estimation of the total Organic Matter Content **OM** as a percentage of dry fine earth fraction in each horizon.
- This is NOT a record of the total organic carbon content.
- It is given in % with one decimal place, *e.g*. 3.8 %.
- The following categories for **OM-O** are:

OM-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of CARBON/NITROGEN RATIO for each Horizon of the Profile

- Record of the Carbon/Nitrogen Ratio (**CN**) to the nearest integer. No decimals allowed.
- The following categories for **CN-O** are:

CN-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of TOTAL CALCIUM CARBONATE CONTENT for each Horizon of the Profile

- The Total Calcium Carbonate $CaCO_3$ (**TCA**) is expressed in % of the fine earth fraction.
- The value should be rounded to the nearest integer.
- The following categories for **TCA-O** are:

TCA-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of GYPSUM CONTENT for each Horizon of the Profile

- The Gypsum content ($CaSO_4.2H_2O$) content (**GYP**) is expressed in % of the fine earth.
- The **GYP** attribute value should be rounded to the nearest integer.
- The following categories for **GYP-O** are:

GYP-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of ACIDITY for each Horizon of the Profile

- The Acidity of the soil horizon (**PH**) is measured in a 1:2.5 soil water suspension.
- If no information on pH in water suspension is available, but a pH measurement obtained with another method is available, estimate the pH(H_20) from the existing pH data.
- The **pH** values should be given to one decimal place.
- The following categories for **PH-O** are:

PH-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of ELECTRICAL CONDUCTIVITY for each Horizon of the Profile

- Electrical Conductivity (**EC**) is measured in a saturated paste extract.
- Code ranges are expressed in $Ds.m^{-1}$ at 25 d°C.
- In non marine humid regions, code ***1*** should be entered if analytical data are absent.

- The following table gives the authorised codes and their meaning for **EC** attribute:

EC codes and their meaning	
1	0 – 4 (free)
2	4 – 8 (slightly affected)
3	8 – 15 (moderately affected)
4	> 15 (strongly affected)

- The following categories for **EC-O** are:

EC-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of SODIUM ADSORPTION RATIO for each Horizon of the Profile

- Sodium adsorption ratio (**SAR**) should be recorded and rounded to the nearest integer.
- In humid areas, SAR is usually less than 4. Unless data for these areas indicate otherwise, enter "**<4**".
- The following categories for **SAR-O** are:

SAR-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Remark: Only one of these parameters, **SAR** or **ESP** (see below), needs to be recorded.

Description of EXCHANGEABLE SODIUM PERCENTAGE for each Horizon of the Profile

- The Exchangeable Sodium percentage (**ESP**) is expressed as a percentage of the Cation Exchange Capacity (**CEC**). The value recorded should be rounded to the nearest integer.
- In humid areas, **ESP** is normally less than 15 % and should be recorded as **"<15"**
- The following categories for **ESP-O** are:

ESP-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Remark: Only one of these parameters, **SAR** (see above) or **ESP**, needs to be recorded.

Description of EXCHANGEABLE BASES for each Horizon of the Profile

- Exchangeable bases Ca, Mg, K, Na, (**EXCH-CA, EXCH-MG, EXCH-K, EXCH-NA**) should be measured using the 1M NH_4AOc at pH 7.0 extraction method.
- The values should be given to one decimal place except when values are lower than 0.1 $cmol^+/kg$.
- The origin of data for exchangeable bases is recorded in one attribute **EXCH-CAT-O**.
- The following categories for **EXCH-CAT-O** are:

EXCH-CAT-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of CATION EXCHANGE CAPACITY for each Horizon of the Profile

- Cation Exchange Capacity (**CEC**) is expressed in $cmol^+/kg$.
- Values are noted to one decimal place for each horizon as the sum of exchangeable bases plus exchangeable acidity at pH 8.1.
- The following categories for **CEC-O** are:

CEC-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of BASE SATURATION for each Horizon of the Profile

- Base saturation (**BS**) is calculated as the percentage of the CEC taken up by exchangeable bases:

$$BS = 100x[(Exch.\ Ca + Exch.\ Mg + Exch.\ K + Exch.\ Na)/CEC]$$

- BS is expressed as an integer number.
- The following categories for **BS-O** are:

BS-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of SOIL WATER RETENTION for each Horizon of the Profile

- Soil Water Retention (**WR**) is the volume percent of water in the soil horizon.

- It is measured at different suctions:

WR-1	Soil Water Retention at 1 kPa
WR-10	Soil Water Retention at 10 kPa
WR-100	Soil Water Retention at 100 kPa
WR-1500	Soil Water Retention at 1500 kPa
WR-FC	Soil Water Retention at Field Capacity

- The volume percent of water in the soil horizon is estimated to the nearest integer value.
- Indicate the most appropriate value for field capacity.
- The origin of data for water retention is recorded in two attributes **WR-O** for **WR-1**, **WR-10**, **WR-100** and **WR-1500**, and **WR-FC-O** for **WR-FC**.
- The following categories for **WR-O** and **WR-FC-O** are:

WR-O and WR-FC-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of TOTAL POROSITY for each Horizon of the Profile

- Total porosity (**POR**) is given in %, to the nearest integer.
- The following categories for **POR-O** are:

POR-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

Description of BULK DENSITY for each Horizon of the Profile

- The bulk density (**BD**) is noted in g/cm^3.
- **BD** values are recorded to two decimal places.
- The following categories for **BD-O** are:

BD-O codes and their meaning	
1	average of a number of profiles
2	from a single representative profile
3	prediction derived from mathematical functions
4	prediction derived from relationships between horizons and class functions (e.g. texture and density class)
5	expert judgement

3.2.2 Examples of estimated soil profile descriptions (Excel® file estimprof.xls)

COUNTRY	STU	WRB-GRP	WRB-ADJ	WRB-SPE	FAO90-MG	FAO90-UNI	FAO90-SUB	PAR-MAT	TWT	HGWL	LGWL	USE	DTC	MERD	MTRD	HOR	*HOR-O*	D-HOR	*D-HOR-O*	STRUCT	*STRUCT-O*	M-COL	D-COL	*COL-O*
FR	184	CM	cr	m	CM	x	c	2111	0	0	0	3	1	50	80	Ap	*2*	18	*2*	7	*2*	7.5YR32	-9	*2*
																Bw	*2*	40	*2*	4	*2*	5YR34	-9	*2*
																BC	*2*	55	*2*	4	*2*	5YR44	-9	*2*
																Cck	*2*	80	*2*	5	*2*	10YR63	-9	*2*
FR	85	VR	ca		VR	k		2140	1	3	5	3	1	60	110	Ap	*2*	25	*2*	7	*2*	10YR22	-9	*2*
																Bw1	*2*	75	*2*	4	*2*	10YR42	-9	*2*
																Bw2	*2*	100	*2*	4	*2*	2.5YR54	-9	*2*
																C	*2*	125	*2*	8	*2*	2.5YR64	-9	*2*
																R	*2*	160	*2*	10	*2*	2.5YR64	-9	*2*
FR	241	LV	ab		PD	d	g	7110	1	1	5	5	8	40	100	Ah	*2*	18	*2*	7	*2*	7.5YR32	-9	*2*
																Eg	*2*	42	*2*	5	*2*	2.5Y62	-9	*2*
																E/Bg	*2*	60	*2*	4	*2*	2.5Y64	-9	*2*
																Btg	*2*	100	*2*	4	*2*	5Y33	-9	*2*
																Btgx	*2*	140	*2*	2	*2*	5Y33	-9	*2*
																Cgx	*2*	170	*2*	2	*2*	5Y44	-9	*2*
FR	246	PZ	ha		PZ	h		5111	1	2	5	5	8	50	120	Ah1	*2*	11	*2*	9	*2*	10YR31	-9	*2*
																Ah2	*2*	23	*2*	9	*2*	2.5YR42	-9	*2*
																E	*2*	38	*2*	9	*2*	10YR51	-9	*2*
																Bhs	*2*	47	*2*	8	*2*	5YR21	-9	*2*
																Bs	*2*	90	*2*	9	*2*	5YR44	-9	*2*
																C	*2*	120	*2*	9	*2*	10YR65	-9	*2*

TEXT-2	TEXT-20	TEXT-50	*TEXT1-O*	TEXT-200	TEXT-2000	*TEXT2-O*	GRAVEL	*GRAVEL-O*	OM	*OM-O*	CN	*CN-O*	TCA	*TCA-O*	GYP	*GYP-O*	PH	*PH-O*	EC	*EC-O*	SAR	*SAR-O*	ESP	*ESP-O*
37	34	12	*2*	4	13	*2*	3	*2*	6.8	*2*	10	*2*	21	*2*	0	*2*	7.9	*2*	1	*2*	<4	*2*	<15	*2*
41	25	9	*2*	3	22	*2*	4	*2*	2.8	*2*	9	*2*	31	*2*	0	*2*	8.0	*2*	1	*2*	<4	*2*	<15	*2*
31	28	8	*2*	4	29	*2*	4	*2*	1.8	*2*	9	*2*	74	*2*	0	*2*	8.0	*2*	1	*2*	<4	*2*	<15	*2*
21	25	13	*2*	8	33	*2*	4	*2*	-9	*2*	-9	*2*	60	*2*	0	*2*	8.2	*2*	1	*2*	<4	*2*	<15	*2*
58	16	9	*2*	4	13	*2*	1	*2*	3.6	*2*	10	*2*	1	*2*	0	*2*	7.4	*2*	1	*2*	<4	*2*	<15	*2*
57	17	11	*2*	3	12	*2*	1	*2*	1.5	*2*	10	*2*	1	*2*	0	*2*	7.9	*2*	1	*2*	<4	*2*	<15	*2*
56	18	7	*2*	4	15	*2*	2	*2*	1.0	*2*	9	*2*	11	*2*	0	*2*	8.1	*2*	1	*2*	<4	*2*	<15	*2*
56	18	9	*2*	3	14	*2*	3	*2*	0.8	*2*	8	*2*	22	*2*	0	*2*	8.1	*2*	1	*2*	<4	*2*	<15	*2*
-8	-8	-8	*2*	-8	-8	*2*	-8	*2*	-8	*2*	-8	*2*	-8	*2*	0	*2*	-8	*2*	-8	*2*	<4	*2*	<15	*2*
12	37	36	*2*	10	5	*2*	0	*2*	3.0	*2*	11	*2*	0	*2*	0	*2*	5.0	*2*	1	*2*	<4	*2*	<15	*2*
13	36	33	*2*	12	6	*2*	0	*2*	0.9	*2*	10	*2*	0	*2*	0	*2*	4.8	*2*	1	*2*	<4	*2*	<15	*2*
22	33	33	*2*	8	4	*2*	0	*2*	0.4	*2*	6	*2*	0	*2*	0	*2*	4.6	*2*	1	*2*	<4	*2*	<15	*2*
32	30	27	*2*	8	3	*2*	0	*2*	0.4	*2*	6	*2*	0	*2*	0	*2*	4.8	*2*	1	*2*	<4	*2*	<15	*2*
29	29	30	*2*	9	3	*2*	0	*2*	0.3	*2*	4	*2*	0	*2*	0	*2*	4.9	*2*	1	*2*	<4	*2*	<15	*2*
24	33	30	*2*	9	4	*2*	0	*2*	-9	*2*	-9	*2*	0	*2*	0	*2*	5.3	*2*	1	*2*	<4	*2*	<15	*2*
2	2	11	*2*	77	8	*2*	1	*2*	13.8	*2*	20	*2*	0	*2*	0	*2*	4.0	*2*	1	*2*	<4	*2*	<15	*2*
2	2	10	*2*	78	8	*2*	3	*2*	3.0	*2*	24	*2*	0	*2*	0	*2*	4.2	*2*	1	*2*	<4	*2*	<15	*2*
2	1	9	*2*	80	8	*2*	2	*2*	1.1	*2*	25	*2*	0	*2*	0	*2*	4.5	*2*	1	*2*	<4	*2*	<15	*2*
5	1	2	*2*	88	4	*2*	1	*2*	1.7	*2*	21	*2*	0	*2*	0	*2*	4.4	*2*	1	*2*	<4	*2*	<15	*2*
4	1	5	*2*	83	7	*2*	0	*2*	-9	*2*	-9	*2*	0	*2*	0	*2*	4.8	*2*	1	*2*	<4	*2*	<15	*2*
10	0	4	*2*	66	20	*2*	0	*2*	-9	*2*	-9	*2*	0	*2*	0	*2*	4.4	*2*	1	*2*	<4	*2*	<15	*2*

EXCH-CA	EXCH-MG	EXCH-K	EXCH-NA	*EXCH-CAT-O*	CEC	*CEC-O*	BS	*BS-O*	WR-1	WR-10	WR-100	WR-1500	*WR-O*	WR-FC	*WR-FC-O*	POR	*POR-O*	BD	*BD-O*
47.2	0.9	1.0	0.1	*5*	34.3	*5*	100	*5*	53	47	38	27	*2*	45	*2*	64	*2*	1	*2*
42.7	0.6	0.5	0.2	*5*	21.7	*5*	100	*5*	49	46	33	26	*2*	44	*2*	52	*2*	1.3	*2*
37.9	0.5	0.3	0.09	*5*	17.4	*5*	100	*5*	47	42	31	17	*2*	35	*2*	52	*2*	1.3	*2*
32.9	0.4	0.1	0.07	*5*	15.4	*5*	100	*5*	50	40	25	17	*2*	39	*2*	56	*2*	1.2	*2*
39.1	2.3	1.4	0.1	*5*	48.8	*5*	100	*5*	52	48	35	27	*2*	44	*2*	55	*2*	1.2	*2*
41.4	2.4	0.6	0.2	*5*	45.2	*5*	100	*5*	54	49	36	27	*2*	44	*2*	58	*2*	1.1	*2*
46.1	0.6	0.5	0.2	*5*	43.3	*5*	100	*5*	53	47	38	27	*2*	44	*2*	53	*2*	1.25	*2*
43.7	2.2	0.5	0.2	*5*	41.8	*5*	100	*5*	50	46	33	27	*2*	44	*2*	51	*2*	1.3	*2*
-8	-8	-8	-8	*5*	-8	*5*	-8	*5*	-8	-8	-8	-8	*2*	-8	*2*	-8	*2*	-8	*2*
2.6	0.5	0.3	0.04	*5*	10.0	*5*	34	*5*	27	25	16	14	*2*	31	*2*	55	*2*	1.2	*2*
0.8	0.3	0.1	0.04	*5*	10.0	*5*	13	*5*	26	24	13	13	*2*	29	*2*	51	*2*	1.3	*2*
4.1	0.1	0.3	0.1	*5*	20.0	*5*	23	*5*	31	26	22	18	*2*	38	*2*	47	*2*	1.4	*2*
7.9	0.2	0.4	0.08	*5*	26.0	*5*	33	*5*	43	39	27	22	*2*	38	*2*	44	*2*	1.5	*2*
8.0	0.2	0.5	0.1	*5*	24.0	*5*	38	*5*	32	30	25	18	*2*	28	*2*	32	*2*	1.8	*2*
-9	-9	-9	-9	*5*	-9	*5*	-9	*5*	30	28	23	18	*2*	28	*2*	30	*2*	1.85	*2*
4.0	1.6	0.5	0.05	*5*	17.5	*5*	35	*5*	15	10	6	4	*2*	8	*2*	63	*2*	0.94	*2*
1.2	0.9	0.09	0.02	*5*	3.2	*5*	69	*5*	15	10	6	4	*2*	8	*2*	63	*2*	0.94	*2*
0.5	0.2	0.06	0.01	*5*	0.8	*5*	95	*5*	16	9	5	3	*2*	7	*2*	46	*2*	1.42	*2*
0.8	0.2	0.04	0.01	*5*	3.3	*5*	33	*5*	20	17	9	4	*2*	7	*2*	48	*2*	1.37	*2*
0.8	0.2	0.04	0.01	*5*	2.9	*5*	37	*5*	20	16	6	5	*2*	8	*2*	43	*2*	1.5	*2*
0.3	0.2	0.07	0.01	*5*	5.1	*5*	11	*5*	22	15	8	7	*2*	11	*2*	38	*2*	1.61	*2*

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In 1985, the Commission of the European Communities (EC) published a soil map of the EC at 1:1,000,000 scale (CEC, 1985). In 1986, this map was digitised to build a soil database to be included in the CORINE project (Co-ordination of Information on the Environment). This database was called the Soil Geographical Database of the EC, version 1. To answer the needs of the MARS project (Monitoring Agriculture by Remote Sensing) of DG VI (Directorate General for Agriculture), the database was enriched in 1990-1991 from the archive documents of the original EC Soil Map and became version 2. The MARS Project of JRC then formed the Soil and GIS Support Group of experts to give advice on the use of this database. The Group recommended that new information should be added and updates should be made by each participating country, leading to the current version 3 of the database, covering the EU–15 and Candidate Countries.

Version 4 of the Soil Geographical Database at scale 1:1,000,000 provides a harmonised set of soil parameters covering Eurasia and Mediterranean countries for use in agrometeorological and environmental modelling at regional, national, and continental levels. In the immediate future, the database will be used for soil protection in general.

The database currently covers Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, FYROM (Former Yugoslav Republic of Macedonia), Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom and Yugoslavia. The extension to Eurasia covers the New Independent States (NIS) of Belarus, Moldova, Russia and Ukraine. The expansion into the Mediterranean Basin will eventually include Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Libya, Malta, Morocco, Palestine, Syria, Tunisia and Turkey.

For the elaboration of the previous versions of the Soil Geographical Database of Europe, instructions for contributors were given through a so-called "Users Guide". The progressive use of this guide during the past 10 years, and the geographical expansion of the database has led to updating the definitions and rules for incorporating the various data, including new attributes into the database. The present Instructions Guide describes the methodology proposed for the elaboration of the database with the aim of facilitating the task of experts, from the new contributing countries, whose task it is to provide information of the highest quality.

MISSION OF THE JRC

The mission of the Institute of Environment and Sustainability is to provide scientific and technical support to EU strategies for the protection of the environment and sustainable development. Employing an integrated approach to the investigation of air, water and soil contaminants, its goals are sustainable management of water resources, protection and maintenance of drinking waters, good functioning of aquatic ecosystems and good ecological quality of surface waters.

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