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Soil Legend Framework for Jamaica

- 3rd Approximation -

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SUMMARY

This Technical Bulletin provides a set of standardized guidelines for soil legend construction in semi-detailed and reconnaissance surveys in Jamaica. The above set of guidelines for soil legend construction, which is referred to as Soil Legend Framework, is an open-ended system in the sense that, within the overall legend structure, new elements can be incorporated when en wherever required.

The Framework has three entry levels: Physiography (1st entry), Lithology (2nd entry) and Soil (3rd entry); the latter entry constitutes the actual map unit itself. Six categories of map unit phases are distinguished but additional phases may be defined where required. Major kinds of soil map units are distinguished and discussed on the basis of their soil composition. Finally, detailed guidelines are given as to the description and presentation of the different kinds of map units.

Key words: Soil legend, landforms, parent material, soil mapping unit, Jamaica.

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1. INTRODUCTION

The Soil and Land Use Surveys carried out during the 1950s and 1960s (RRC 1956-1970) provide ample evidence of the close relationship between physiography, lithology and soils in Jamaica. Clearly, soils with the same physiography and developed on similar rocks tend to have similar characteristics and similar overall suitability for agriculture, when occurring within identical agro-climatic zones.

In view of their close relationship with the soil and their excellent visibility on aerial photographs in Jamaica, physiography (or landform) and lithology (parent material/rock) can adequately serve as main entries to soil legends. An important advantage over the usual soil taxonomic entries is the fact that structuring soil legends on the basis of physiography and lithology greatly enhances the users general insight of the spatial distribution of the soil in relation to its geographic setting (Sombroek and Van de Weg 1980).

The above considerations and principles formed the basis on which soil legend frameworks were developed in the past. In this Bulletin these legend framework are referred to as the 1st Approximation (SSU 1985) and the 2nd Approximation (SSU 1986).

This Technical Bulletin presents the 3rd Approximation of the Legend Framework and is derived from the first two Approximations. It is open-ended in the sense that, within the overall legend structure, new elements can be incorporated when and wherever required in the future. The gradual expansion of the framework will be a natural process, generated by on-going soil survey work. A good example, in this report, is the Plateau (U) unit (see Table 1), which was recently identified and defined on the basis of field investigations.

Chapters 2, 3, and 4 of this Bulletin describe the three entry levels of the legend framework. Chapter 5 deals with phases of soil map units, while the last chapter discusses the construction of soil legends.

2.1 THE FIRST LEGEND ENTRY: LANDFORM

2.1 Introduction

Landform (physiography) is used as the first legend entry. Eight broad landforms have been defined in the 3rd Approximation on the basis of

(a) Overall relief intensity.

(b) Average slope gradient class.

(c) Mean elevation above sea level.

Relief intensity is defined as the vertical difference between higher and lower points of the landscape e.g. between summits/crests and valley bottoms.

The various landforms and their general characteristics are described in Table 1. Landform is shown in the map unit code using a capital letter. It should be noted here that distinctions and definitions have been made in relation to soil mapping legend construction. Consequently, pedologic significance rather than geomorphic purity has been the main consideration with regard to the distinction of landforms.

2.2 The Different Landforms

The landforms are defined in more detail as follows:

Mountains (M)
Mountains include erosion and volcanic landscapes with a relief intensity of at least 200m, with most of the area comprising the zone between the valley and summit. Slopes are generally over 30%. Mountains may occur as single, isolated features or in a group forming a long range. Mean elevation is over 600m.
Example: Blue Mountains.

Table 1. Description of landforms

LANDFORM SYMBOL	OVERALL RELIEF INTENSITY (m)	AVERAGE SLOPE GRADIENT (%)	MEAN ELEVATION (m)
M - Mountains	› 200	Very steeply dissected (›30%)	› 600
H - Hills and Foothills	20 - 200	Variable (8-50%)	Variable
U - Plateau	5 - 20	Undulating to rolling (2-16%)	- do -
B - Inland Basin	5 - 20	Almost flat to undulating (0-8%)	- do -
A - Alluvial fan	‹ 10	Variable (0-16%)	- do -
P - Plain	‹ 10	Almost flat to gently undulating (0-5%)	- do -
T - Tidal Flats	‹ 5	Flat to almost flat (0-2%)	‹ 10

Hills and Foothills (H):

Hills and Foothills are elevated areas rising distinctly above the surrounding plain or plateau. Hills show a recognizable pattern of cone-shaped summits or linear crests. They may also occur as isolated units e.g. Kemps Hill. Relief intensity, compared to surrounding landscape, varies from 20-200m and slopes generally range from 8-50%.
Example: Cockpit Country

Plateau (U)

A Plateau is a relatively level area of considerable extent which rises substantially above the surrounding landscape. Plateaus are commonly bounded on at least one side by a steep slope or scarp. Also, they may be surrounded by hills or mountains. In Jamaica, they are usually tectonic in origin.
Example: Burnt Ground area (Hanover)

Inland Basin (B)

An Inland Basin is a large, somewhat concave depression of tectonic origin with almost level to undulating topography. Most inland basins lacked an outlet in the past which caused groundwater and surface water to accumulate with subsequent accumulation of fine sediments. Flooding and sedimentation still frequently occur in some of the inland basins.
Example: Lluidas Vale Basin.

Alluvial Fan (A):

An Alluvial Fan is a low, gently sloping cone of alluvial sands and gravels extending from the base of the mountains or hills. The apex, or central point of the fan lies at the mouth of a valley gorge or canyon and is built out upon an adjacent plain (Strahler 1975).
Example: Liguanea Plain.

Plains (P):

Plains include (a) Coastal Plains as well as (b) River Plains and Valleys.

(a) Coastal Plains comprise flat to very gently undulating areas with only few prominent features. Relief intensity is less than 10m. Coastal Plains may be formed by erosional or depositional processes.

(b) River Plains and Valleys which include former and present flood plains of rivers which are generally separated from the surrounding landscape by a gentle to abrupt drop in slope.
Examples: St. Catherine Coastal Plain (Coastal Plain)
Upper Rio Cobre Valley (River Plain)

Tidal Flats and Swamps(T):

Tidal Flats and Swamps include permanently flooded inland freshwater swamps as well as mangrove swamps and brackish marshlands subject to tidal flooding.
Example: Black River Morass

Areas of non-soil (N) key out at the first level as they are miscellaneous landtypes. They include e.g. urban areas and rockland and will be discussed in Chapter 3.

3. THE SECOND LEGEND ENTRY: LITHOLOGY

Lithology is used to subdivide physiographic units and is indicated with a second capital letter. A differentiation is made between Parent Rock which denotes the consolidated bed-rock underlying the soil profile, Parent Material, which is an unconsolidated derivative of one or several types of parent rock, and Organic Materials, which consist of organic deposits that accumulate in poorly drained, wet places where organic matter production exceeds decomposition.

The letter symbols for lithology are usually derived from the first letter of the name of the parent rock. However, since some of the first letters are similar, this rule could not always be applied strictly. The abbreviations are as follows:

(1) Parent Rocks

a) Sedimentary Rocks
- C - Conglomerate (to be specified in report)
- S - Sandstone (calcareous)
- Z - Non-calcareous sandstone
- U - Calcareous shale
- T - Non-calcareous shale
- L - Hard limestone
- J - Undifferentiated limestone
- Y - Soft yellow limestone
- X - Undifferentiated sedimentary rocks (to be specified in report)

b) Metamorphic Rocks
- M - Marble
- D - Slates
- I - Schists
- H - Hornfels
- E - Serpentine
- Q - Undifferentiated (metamorphosed conglomerate, tuffs, slates etc.)

c) Igneous Rocks
N - Porphyry
G - Granodiorite
A - Andesite
B - Basalt

d) Pyroclastic Rocks
K - Tuffs

(2) Parent Materials

O - Old alluvial deposits (to be specified in report)
R - Recent alluvial deposits
V - Colluvial deposits
F - Fluvio-colluvial deposits

(3) Organic Material
P - Peat

Miscellaneous landtypes are subdivided at the 2nd entry level of the legend framework. To avoid confusion with the lithological codes, subdivisions are indicated with common letters instead of capital letters as used for lithology. So far, 7 subdivisions have been recognized, as follows:

Nb - Beaches
Ng - Gullies
Np - Ponds
Nq - Quarries
Nr - Rockland
Nu - Urban area
Nw - Wetlands

4. THE SOIL MAP UNITS

The Soil Map Unit code for consociations is formed by adding an arabic number to the symbols of the first two entries. This arabic figure is preceded by a letter in case the code represents a compound map unit e.g., soil associations (y), complex (x) or undifferentiated (z) groups. (see Chapter 6). Possible types of map unit codes thus are:

B03 - The third consociation of soils occurring in inland basins (B) and developed on Old Alluvium (0)

B0x2 - The second complex of soil occurring in inland basins and developed on Old Alluvium.

B0y1 - The first association of soils occurring in inland basins and developed on Old Alluvium.

For cartographic reasons, the map unit code is kept as concise as possible. All other information relating to kind of map unit and soil characteristics of taxomomic components (series) are represented in the descriptive part of the soil legend (see Chapter 6).

5. THE MAP UNIT PHASES

5.1 General

The phases as described hereafter relate to map units rather than to taxonomic units. USDA (1975) refers to such "map unit phases" as area distinctions. Phases significantly affect land use and management. They are therefore delineated on the map and indicated with common letters that are put underneath the code of the "soil map unit" proper, for instance, B03/c. It should be noted, however, that the delination of phases depends on the scale and purpose of the survey. It is often not practical to map phases separately at the 1:25,000-1:50,000 scale commonly used in soil surveys.

Further details are given in Chapter 6. Phases for slope, salinity, sodicity, gravelliness, stoniness and rockiness are described in the following sections. Additional phases such as calcareousness or depth of groundwater may be defined where required.

5.2 Slope

Slope classes and their range in slope gradient based on criteria of FAO (1977) with slight modifications are shown in Table 2. The descriptive terms express slope class and thus do not imply any statement about physiographic position: "hilly areas" with 16-30% slope occur both within the landtype Mountains (M) and Hills and Foothills (H).

Table 2. Key to slope classes.

Overall range in maximum slope gradient (%)	Slope class	Symbols
0 - 2	Flat to almost flat	a
2 - 5	Gently undulating	b
5 - 8	Undulating	c
8 - 16	Rolling	d
16 - 30	Hilly	e
30 - 50	Steeply dissected	f
> 50	Very steeply dissected	g

5.3 Salinity

Salinity classes (z) are delineated on the map, when the electrical conductivity in a saturated paste (ECe) exceeds a certain critical value for crop growth. The depth of occurrence of the saline layer (SSU 1987) is also taken into account (Table 3). ECe ranges are based on internationally accepted classes (USDA 1954):

1 : Non-saline - ECe 0-4 (mS/cm at 25 C)
2 : Slightly saline - ECe 4-8
3 : Moderately saline - ECe 8-15
4 : Strongly saline - ECe over 15

Table 3: Key to salinity classes

Depth (cm)	z0	z1	z2	z3	z4
0 - 20	1	1	1	1	2-4
20 - 40	1	1	1-2	2-3	2-4
40 - 60	1	1	2-3	2-4	2-4
60 - 80	1	1-2	2-3	2-4	2-4
80 - 100	1	2-3	2-3	2-4	2-4

A general interpretation of salinity classes is as follows:

z0 : No risk of salinity
z1 : Low risk of salinity
z2 : Moderate risk of salinity
z3 : High risk of salinity
z4 : Very high risk of salinity

When salt levels in the soil are not harmful to sensitive crops the salinity phase is not delineated on the map.

5.4 Sodicity

Sodicity classes (s) are only delineated on the map when the Exchangeable Sodium Percentage (ESP) within a depth of 50 cm of the surface exceeds

the value of 15%, which is considered critical in relation to structural stability and workability of most soils.

Table 4: Key to Sodicity Classes

Code	ESP (between 0-50 cm depth)	Interpretation
s0	0 - 15%	Low sodicity risk
s1	15 - 35%	Moderate sodicity risk
s2	› 35%	High sodicity risk

5.5 Gravelliness *)

Classes of gravelliness are indicated with the letter 'k', the following classes have been distinguished:

k0	:	Non-gravelly	Gravel covers less than 0.01% of the surface area.
k1	:	Fairly gravelly	Gravel covers 0.01% to 0.1% of the surface area.
k2	:	Gravelly	Gravel covers 0.1 to 2% of the surface area.
k3	:	Very gravelly	Gravel Covers 2 to 25% of the surface area.
k4	:	Extremely gravelly	Gravel covers 25 to 75% of the surface area.

*) Size ranges are defined as follows:
Gravel : 0.2 - 7.5 cm
Stones : 7.5 - 25 cm
Rocks : › 25 cm

k5	:	Gravel land	Gravel covers more than 75% of the surface area.

5.6 Stoniness *)

Stoniness classes are indicated with the letter 'c'. They closely follow the definitions proposed in the FAO Guidelines of Soil Description (FAO 1977) except for the last two classes.

c0	:	Non-stony	No stones, or stones cover less than 0.01% of the surface area.
c1	:	Fairly stony	Stones cover 0.01 to 0.1% of the surface area i.e. stones 15 to 30 cm in diameter and 10-30m apart.
c2	:	Stony	Stones cover 0.1 to 3% of the surface area, i.e. sotnes 15 to 30cm in diameter and 1.60 to 10m apart.
c3	:	Very stony	Stones cover 3 to 15% of the surface area, i.e. stones 15 to 30cm in diameter and 0.75 to 1.60m apart.
c4	:	Exceedingly stony	Stones cover 15 to 75% of the surface area, i.e. stones 15 to 30cm in diameter and 10 to 75cm apart.
c5	:	Rubble land	Stones cover more than 75% of the surface area, i.e. stones 15 to 30cm in diameter and less than 10cm apart.

*) Size ranges are defined as follows:
Gravel : 0.2 - 7.5cm
Stones : 7.5 - 25cm
Rocks : > 25cm

5.7 Rockiness *)

Rockiness classes are indicated with the letter 'r'. They closely follow the definitions of FAO Guidelines for Soil Description (FAO 1977) except for the last two classes.

r0	:	Non-rocky	No rock out crops or rocks cover less than 2% of the area.
r1	:	Fairly rocky	Rock exposures are roughly 35 to 100m apart and cover 2 to 10% of the area.
r2	:	Rocky	Rock exposures are roughly 10 to 35m apart and cover 10 to 25% of the area.
r3	:	Very rocky	Rock exposures are roughly 3.5 to 10m apart and cover 25 to 50% of the area.
r4	:	Extremely rocky	Rock exposures are 3.5m or less apart and cover 50 to 75% of the area.
r5	:	Rock outcrops	Rock exposures cover more than 75% of the area.

*) Size ranges are defined as follows:
Gravel : 0.2 - 7.5 cm
Stones : 7.5 - 25 cm
Rocks : › 25 cm

6. THE CONSTRUCTION OF THE SOIL LEGEND

6.1 Kind of Map Units

USDA (1985) distinguishes 4 major kinds of map units which are divided into single and compound map units as follows:

a) Single Map Unit

Consociation:	A map unit dominated by a single soil taxon (e.g. series of family) and containing less than 25% inclusions of dissimilar soils.

b) Compound Map Units

Association:	A map unit consisting of two or more soil taxa (e.g. series or family) geographically associated in a characteristic recurring pattern. It contains less than 25% inclusions of dissimilar soils.
Complex:	Similar to association but the constituent soil taxa occur in such an intricate pattern or are so small in area that it is not practical to map them separately even at the scale of the sample area survey. The pattern and proportions of soil taxa are somewhat similar in all areas. A complex contains less than 25% inclusions of dissimilar soils.
Undifferentiated Groups:	A map unit consisting of two or more soil taxa (e.g. series or family) that are not consistently associated geographically but are included in the map unit because use and management are the same or very similar. Soil taxa occur in variable proportions in various soil delineations representing the map unit.

6.2 Description of Map Units

The different symbols for making map unit codes have been discussed in Chapters 4 and 5. The naming of map units is modified after USDA standards (USDA, 1985) to suit Jamaican conditions. An example is given below for each kind of map unit.

Consociation :	Series name + dominant texture of surface layer (0-25cm). Example: PENNANTS clay.
Association :	Dominant series + minor series + 'association' Example: MEARS-SEVENS association.
Complex :	Dominant series + minor series + 'complex' Examples: AGUALTA - RHYMESBURY complex.
Undifferentiated :	Indicated 'and' between the various constituents + 'soils' Example: UNION HILL and BONNYGATE soils.

When forming names of compound map units the dominant soil taxon (series) is named first. For example:
65% Agualta and 30% Rhymesbury: Agualta - Rhymesbury complex
55% St. Ann and 35% Bonnygate: St. Ann - Bonnygate complex

An example of a complete map unit description including code, name and brief soil description is given below:

HY4 **CARRON HALL clay:** moderately deep, imperfectly drained, very firm, yellowish brown, calcareous, cracking clay over soft limestone.
(*Fine, montmorillonitic, isohyperthermic Typic Chromuderts)*

The following terminology modified from Andriesse & van der Pouw (1985) is used in map unit descriptions when referring to special topsoil or subsoil characteristics of the individual soil series:

" with a humic topsoil" refers to a mollic A or a eutric histic H horizon.

" with an acid humic topsoil" refers to an umbric A or a dystric histic H horizon.

" with a thick topsoil of ....." indicates that the topsoil is 30-60 cm thick.

" with a topsoil of ....." is used when the topsoil texture differs by more than two classes from the subsoil texture.

" abruptly underlying ....." refers to an abrupt textural change of the kind encountered in Planosols (e.g. Tydixon series belonging to the Albaquults).

" with a ..... deeper subsoil" is used to describe the characteristics of the subsoil below a depth of 80 cm when they significantly differ from those of the "overlying" subsoil (e.g. with a calcareous deeper subsoil).

" over ....." refers to the material/rock on which the soil occurs (e.g. over weathered grandiorite).

Inclusions and other features of the map units are not indicated in the legend itself but described in the main report.

The Soil Taxonomy family to which the series belong is indicated between brackets since this information is mainly of interest to the specialist user of the soil map. Map unit phases are explained in a 'Key to Phases' indicated on the map - which should also include a textural diagram and an explanation of depth classes used.

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