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LEGENDS FOR SEMI-DETAILED SOIL MAPS

The proposed entries for Jamaica

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CONTENTS

1. GENERAL

From the Soil and Land Use reports of Jamaica (RRC, 1958-1970) follows that a close relation exists between physiography, lithology and broad soil landscapes. Because physiography (or landform or landtype) and lithology are strongly related to soil conditions (see BUOL & McCRACKEN, 1980) and have high visibility on aerial - photographs (see MULDERS, 1982) they are appropriate criteria for main entries on a soil legend. Also, because they enhance the users' general insight on the spatial distribution of broad soil landscapes occurring within a geographic area and also on their range of elevation and slope, and intensity of relief. These topics have been documented by SOMBROEK & VAN DE WEG (1980).

Figure 1 shows how changes with time in the climate, land use and hydrology determine soil conditions within a physio-lithological unit. The combined effect of these soil forming factors are reflected in a soil by the type and degree of profile differentiation (genetic). Soils of the same landform and developed on similar rocks and with similar genetic profile development have generally similar overall suitability for agriculture when occurring within identical agro-climatic zones. Hence, by using these three criteria as entries on the legend the link between soils and their potential for general agriculture is already established.

Further divisions on the legend are according to specific characteristics of soils such as depth, drainage condition, texture, colour, stoniness and so on. This information is briefly described on the legend attached to the soil map to give the user information on soils without having to refer to the accompanying soil survey report. To further increase the information on the soil map, classification for major soils are added. At a scale of 1:25,000 - 1:50,000 the USDA Soil Taxonomy (1975) is the accepted system in Jamaica, whereas at country level either this or the FAO/UNESCO (1974) system are used as is the case for CRIES (1983) and BATJES (1985) respectively.

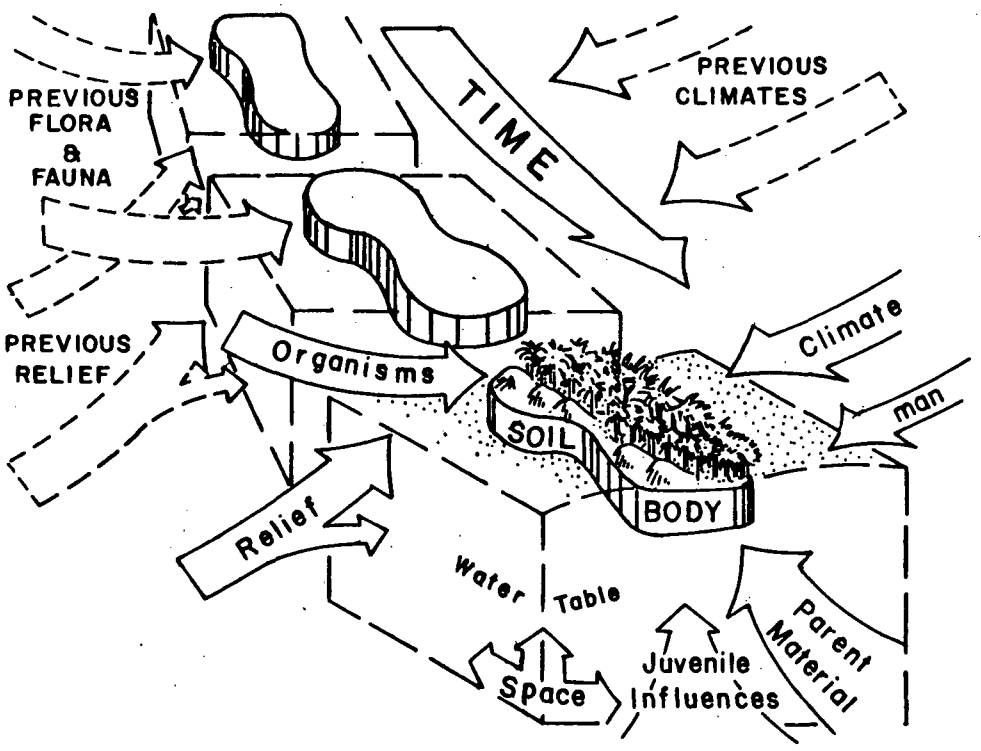

Figure 1 : "Freight train" diagram of factors of soil formation.
(Modified from : P BUOL AND McCRACKEN 1980)

Classification of soils in semi-detailed and detailed surveys is at "family level"; the "series" is a division of a "family".

At scale up to 1:50,000 most mapping units are soil - consociations however, there may also be some associations, complexes and undifferentiated groups. The above concepts are discussed in the Soil Survey Manual (USDA, 1984) and briefly summarized in Chapter 7.

Chapter 2 describes the criterion used at the first level of entry on the legend; that is division according to physiography. Divisions based on lithology are presented in Chapter 3 and those based on the type and degree of profile differentiation in Chapter 4. Entries that relate directly to morphometric soil characteristics are presented in Chapter 5. The division of mapping - units into their respective phases is discussed in Chapter 6.

2. PHYSIOGRAPHY

Physiography or landform, is the first criterion used as entry on the soil legend. Separation amongst physiographic units is based here on: 1) overall range in elevation; 2) range of slope gradient; 3) intensity of relief which relates to the amplitudo of the landform.

The concepts of the physiographic units are derived from the General Soil Map of Jamaica at scale 1:250,000 (BATJES, 1985) and their descriptions shown in Table 1.

Areas of non-soil (N) key out also at the first level since they are miscellaneous land types. They include eg. urban areas and beaches and will be discussed further in Chapter 3.

3. LITHOLOGY

Lithology is used to divide physiographic units and indicated with a second capital letter. A differentiation is made between parent-rock, parent-material and organic materials (peat).

Table 1: Description of landforms

Landform symbol	Elevation (m)	Overall relief intensity (m)	Overall slope gradient (%) & Slope class* -
M - Mountains	>800	>300	Very steeply dissected (>50%)
H - Hills & Foothills	60-800	20-200	Variable, but generally 16-50%
B - Inland Basins	100-150	<10	Rolling (8-16%)
A - Alluvial Fans	Variable	<10	Undulating (2-8%)
P - Coastal Plains	<60	<10	Almost flat to gently undulating (0-5%)
R- River Plains & Valleys	Variable	Variable	Undulating (2-8%)
T - Tidal Flats & Swamps	<10	<10	Flat to almost flat (0-2%)

* Note : These terms denote complex slopes (after FAO, 1977).

Parent-rock denotes the consolidated bedrock underlying the soil profile, whereas parent-material is an unconsolidated derivative of one or several types of parent-rock. Peat are termed those organic deposits that accumulate in poorly drained, wet places where organic matter forms more rapidly than it decomposes.

Abbreviations for lithologic entries are generally derived from the first letter of the parent rock or material. However, since some of the first letters are similar this 'general' rule cannot be applied strictly. The abbreviations are:

Parent materials:

O - Old alluvial deposits
R - Recent alluvial deposits
V - Colluvial deposits
F - Fluvio-colluvial deposits

Parent Rocks

*Sedimentary rocks:

C - Conglomerate
S - Sandstone (calcareous)
Z - Non-calcareous sandstone
U - Calcareous shale
T - Non-calcareous shale
L - Hard limestone
Y - Undifferentiated limestone (specify in report)
J - Reef limestone
X - Unfidderentiated sedimentary rocks (specify in report)

*Metamorphic rocks

M - Marble
D - Slates
I - Schists
H - Hornfels

E - Serpentine

Q - Undifferentiated (metamorphosed conglomerate, tuffs, slates etc.)

*Igneous rocks

N - Porphyry

G - Granodiorite

A - Andesite

B - Basalt

* Pyroclastic rocks

Y - Tuffs (lava flows)

Organic materials

P - Peat

Codes at the second level of entry on the legend are of the general form PO, where P relates to physiography and O to lithology e.g. Soils occurring on Plains and formed on old alluvium.

Miscellaneous land-types are also divided at the second level of entry on the legend. To avoid confusion with the lithological codes, divisions are indicated with common letters instead of the capital letters as used for lithology. So far, 6 divisions have been recognized; they are:

Nu - Urban areas

Nb - Beaches

Nr - Rockland

Ng - Quarries

Np - Ponds

Nw - Wetlands

4. TYPE AND DEGREE OF PROFILE DEVELOPMENT

The degree and type of profile development is considerered at the third level; it is a genetic division.

Third level entries only correlate partially with orders, sub-orders or great-groups of Soil Taxonomy (Table 2). The class "moderate" is a somewhat arbitrary one because in fact it should be "weak to moderate". The "moderate class" is created to keep Vertisols, with their specific management problems, as a clearly defined entity on the map. "Very strong" relates to soils with strongly weathered mineralogy as reflected in a Cation Exchange Capacity of less than 16 or 24 meq/100 g of clay size minerals at pH 7 by the 1N Ammonium-acetate method for Oxisols respectively oxic-subgroups.

Table 2. Classes of profile "differentiation" of soil (genetic)

Symbol	Class	Order/suborder/great group
a	very weak	Entisols
b	weak	Inceptisols & Mollisols without argillic horizon
c	moderate	Vertisols
d	strong	Alfisols, Utisols & Mollisols with argillic horizon
e	very strong	Oxisols and oxic subgroups

Note: "Differentiation" includes the degree and type of soil formation.

5. SOIL CHARACTERISTICS ENTRIES

The main characteristics of the major soil or soils, depending on the type of map unit, are described at the fourth level of entry on the legend. These brief soils descriptions enhance the user's understanding of the soil map and may make the reading of the accompanying soil survey report superfluous for the 'quick' reader.

The descriptions relate to characteristics of the subsoil, generally the B-horizon, up to a depth of 100 cm from the surface or less if hard rock or a permanent water table occur at a shallower depth. They are according to an accepted format;

- depth class (see 6)
- drainage class (see FAO, 1978)
- colour moist (MUNSELL 1957)
- textural class or textural group (recent alluvial soils)
- mottling
- salinity
- sodicity
- stoniness or rockiness and
- other features relevant to land management.

Some surface layers (mainly A-horizons) have characteristics that differ significantly from those of the subsurface layer (mainly B-horizons). For example, a contrasting particle size, or a mollic or umbric epipedon (see USDA, 1975). Since these features affect land management, they are also described on the legend. For example:

- - - underlying 10 to 30 cm sand, or
- - - underlying 20 to 40 cm humic clay loam (mollic epipedon), or
- - - underlying 30 to 40 cm acid humic clay loam (umbric epipedon).

Similarly, contrasting textures in the subsoil are also described when occurring within 100 cm of the surface; that is when occurring within the control section as defined by USDA (1975). For example:

- - - with yellowish brown sand below 70 cm.

Summarizing, the complete code of a mapping unit is of the general form HLe4, where:

HL - Soils formed on limestone

HLe - Soils with very strong profile differentiation

HLe4 - St. Ann clay loam: deep, well drained, dark reddish brown to dusky red, friable, clay loam (Typic Eutrorthoxs).

6. SOIL PHASES

Phases are divisions of soil mapping units based on characteristics that are not inherent to a specific type of soil; a phase is thus not diagnostic in separating soil series according to USDA (1984). Because phases affect significantly land use and its management they are delineated on the map and indicated with common letters that are put underneath the code of the "soil mapping unit" proper (eg. POc1/s); see also Chapter 7).

Slope: Slope classes (a, b, c, d, e and f) are based on the range in compound slope following criteria of FAO (1977). The included descriptive terms express a complex (compound) slope class (Table 3) and thus do not imply any statement about the physiographical occurrence. "Hilly areas" with 16 to 30% slopes occur both within the physiographic unit (M) Mountains and (H) Hills and Foothills.

Table 3: Key to complex-slope classes (After FAO, 1977).

Symbol	Slope Classes	Range of Slope Gradient (%)
a	flat to almost flat	0 - 2
b	undulating	2 - 8
c	rolling	8 - 16
d	hilly	16 - 30
e	steeply dissected	30 - 50
f	very steeply dissected	over 50

Salinity: Salinity classes (Z) are delineated on the map when the electrical conductivity in a saturated paste (ECe) exceeds a certain value considering the depth of occurrence of this saline layer. The proposed ECe ranges are derived from salinity surveys of RPPD:

- 1: non-saline ECe = 0 - 4 (mmhos/cm at 25° C).
- 2: slightly saline ECe = 4 - 8
- 3: mod. saline ECe = 8 - 13
- 4: strongly saline ECe = over 13

The depth to the saline layer is introduced as shown in Table 4.
The classes can be interpreted as follows:
Z0: very high absence of salinity (no risk of salinity)
Z1: high absence of salinity (low risk of salinity)
Z2: moderate absence of salinity (moderate risk of salinity)
Z3: low absence of salinity (high risk of salinity)
Z4: very low absence of salinity (very high risk of salinity)
When salt levels in soils are not harmful to most crops (class Z0) no salinity phase is delineated on the map. Class Z1 through Z4 are delineated because they affect negatively crop growing in an ever increasing way.

Table 4: Key to Salinity Classes

	Salinity Class				
depth (cm)	Z0	Z1	Z2	Z3	Z4
0 - 20	1	1	1	1-2	2-4
20 - 40	1	1	1-2	2-3	2-4
40 - 60	1	1	2-3	2-3	2-4
60 - 80	1	1-2	2-3	2-4	2-4
80 - 100	1	2-3	2-3	2-4	2-4

Sodicity: Sodicity classes (N) are only delineated on the map when the exchangeable Sodium Percentage (ESP) below 30 cm depth exceeds the critical value of 10%. (Table 5).

Table 5: Key to sodicity classes*

Code	ESP (%)	Name
N0	0 - 10	high absence of sodicity
N1	10 - 20	moderate absence of sodicity
N2	20 & more	low absence of sodicity

* below 30 cm

Stoniness: Stoniness (R) is delineated as a phase when making the use of machinery impracticable. In a stony-phase over 30% of the surface is covered by rock fragments - 15 to 30 cm in diameter - that are about 1.6 to 10 cm. apart. Further divisions may be required for detailed surveys at farm level, for example according to FAO (1977).

Soil depth: Depth classes are: very shallow (less than 25 cm), shallow (25 - 50 cm), moderately deep (50 - 100 cm) and deep (over 100 cm). Soil depth often keys out above the phase level because it can be diagnostic for a soil (e.g. lithic properties; "fine over coarse-loamy", etc.). Accordingly, it is only described on the soil legend and not reflected by a code.

7. CONSTRUCTION OF THE SOIL LEGEND AND MAP CODES

7.1 Major map units

Soil Survey staff of USDA (1984) considers four mapping units in their soil surveys, namely:

- consociation: A mapping unit of one kind of soil (series) and less than 25% of "inclusions".

- Association: A group of soils (series) geographically associated in a characteristics repeating pattern and defined and delineated as a single map unit, and containing less than 25% of "inclusions".

- complex: A map unit of two or more kinds of soil occurring in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of soils are somewhat similar in all areas. Each area contains less than 25% of "inclusions".

- undifferentiated: Two or more kinds of soil, showing similar suitability limitations for land use, that are delineated as one unit on the map. Each of these units may or may not contain all of the constituting soils, since they may occur in variable proportion in different areas.

Different codes are proposed for each type of map units, namely:

- consociation : HLd4
- compound units : HLX1

The code for compound units (associations, complexes and undifferentiated groups) is proposed for cartographical reasons; that is to limit the length of the code; the nature of the unit will be expressed in its name. Each map unit is given a name because systematic Soil and Land-Use Surveys have been carried out in Jamaica from 1958 to 1970 (RRC) the "old" "series names" are used whenever possible. However, because the concept of some series had to be changed some 'old' names were adapted after correlation. Naming of map units is partly according to USDA - standards (1984). The names are respectively of the form:

- consociation: series name + dominant texture of surface layer (0-25 cm)

- association: dominant series + minor series + association (e.g. St. Ann - Bonnygate association)

- complex: dominant series + minor series + a) dominant texture of surface layer if similar, or b) complex if the series have disimilar texture in the surface layer.
  (e.g.) a) Agualta - Rhymesbury clay, b) Sevens-New Yarmouth complex).

- undifferentiated: include and between the various constituting elements (e.g. Union Hill and Bonnygate and Rockland).

When forming names of compound mapping units, the most extensive component (series) is named first. For example:-

(a) 65% Agualta - 30% Rhymesbury: Agualta - Rhymesbury clay

(b) 55% St. Ann - 35% Bonnygate: St. Ann - Bonnygate complex

No differences are made between A-R and R-A complexes or associations when the relative proportions of A and R do not affect markedly the overall suitability for agriculture [eg. two fine, montmorillonitic, isohyperthermic, Typic Chromuderts].

An example of a complete map unit description, as written on the map follows:

POc1: Parnassus clay: Deep, imperfectly drained, yellowish brown cracking clay (Typic Chromusterts).

POc1 and Parnassus clay, are respectively the code and name of the map unit. Next follows a brief description of the dominant soil (s), and thereafter the USDA Soil Taxonomy (1975) classification at subgroup level.

7.2 Phases of 'major map units'

Some factors like slope, salinity, sodicity, texture of the surface layer, etc. affect the overall suitability for agriculture of otherwise similar soils ("families"). They are visualized within the "major map units". (e.g. POc1) at phase level.

All phases of a "major map unit" can be named separately on the legend, as is done by USDA - soil survey staff (1984). This results, however, in very long legends that can be confusing or incomplete as is outlined below. Staff from other national and international soil survey organizations therefore prefer to indicate phases at a 'lower' level of differentiation on the legend; that is as a separate "key to phase" (e.g. STIBOKA, KENYA SOIL SURVEY, FAO/UNESCO). This method presents as advantage that some

features like strong salinization, will always be visualized on the map even when they are inherent to a soil series. When using the USDA-norm (1984) this would not be so thereby yielding a less "complete" picture on the map; a Typic Halaquept would not get a code for sodicity because sodicity is diagnostic at great-group level. This implies that when adjacent to a non-saline but related soil (e.g. Typic Tropaquepts), the difference in salinity is not visualized on the map resulting in loss of vital information to the user.

For brevity and clarity's sake it is proposed to indicate "phases" within "major map units" and to present a separate "key to phases" on the map legend thus, the characteristics that relate to "phases" are shown in the map code as follows:

POc1	"major map unit"
bZ1	"phase"

Soil phases are indicated at the map by thinner lines than those used to delineate "major map units" (e.g. RPPU, 1985).

Finally, it must be stated that both the 'present' and USDA (1984) approach have their own draw-backs.

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ERRATA

page 5 line 23 Y - Undifferentiated limestone etc. =
J - Undifferentiated limestone etc.

page 5 line 24 J - Reef limestone = Y - Soft limestone

page 6 line 9 Y - Tuffs (lava flows) = K - Tuffs (lava flows)

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