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Report to the Government of

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SOIL SURVEYS

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ROME, 1966

Project GUY/TE/LA

REPORT TO THE GOVERNMENT

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on

SOIL SURVEYS

by

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I INTRODUCTION

From last January, 1965 until the end of June, 1966, Dr. J.G. Steele, Technical Officer, Soil Surveys, was assigned by the Food and Agriculture Organization of the United Nations to the Government of British Guiana (now Guyana). The terms of reference were:

> " Technical and administrative supervision of the Government Soil Survey programme within the policy outlines and programme schedules as established by the Soil Advisory Board.
>
> Consult with and advise the Government on problems relating to soil classification, survey, and use.
>
> Train Government soil survey personnel in technique of soil survey, classification of soils according to their agricultural use, capability, and general crop-soil relationship."

This assignment was a continuation of work done by Clyde C. Applewhite, under the same terms of reference, during the first half of 1964. Broadly stated, the two-year project was to assist soil survey officials of the Government in the transition from a relatively large soil survey programme, directed and largely staffed by outsiders, and financed mostly from the outside, to a continuing programme conducted by the Soil Survey Staff within the Ministry of Agriculture, and financed as part of the Government development programmes.

The need for soil surveys was stressed in reports of several economic missions to British Guiana, in particular a report in 1953 by the International Bank for Reconstruction and Development. Soil Surveys were made by a technical mission from the United States in 1955-56; by the Regional Research Centre of the British Caribbean resulting in publications in 1958 and 1959; and by Soil Surveyors of the Department of Agriculture from time to time. In 1961-64 the Food and Agriculture Organization of the United Nations, under a joint project of the United Nations Special Fund and the Government, made a reconnaissance soil survey of the entire country, made semi-detailed soil surveys of three areas amounting to nearly 2,100,000 acres, strengthened the soils laboratory and provided some equipment for it, began plot experiments to study performance of named kinds of soil, and trained a Soil Survey Staff to carry on the work of mapping and interpreting soils.

Before the joint British Guiana-United Nations Soil Survey project came to an end in May, 1964, the Soil Survey Unit in the Division of Chemistry and Soils was established to carry on the work of mapping, classifying and interpreting soils. Under the direction of H. N. Ramdin, Soil Surveyor, soil surveys were made of several areas in 1964 and 1965, and the work is continuing. A soil map and report are prepared for each area surveyed, and copies are reproduced for the Government agencies concerned and for the files.

The F.A.O. expert found in 1965 a competent Soil Survey Staff, well trained to carry out the day-to-day operations of studying and describing soils and making soil maps, including the management of soil survey camps and field parties. The formal organisation, however, had not been established, and key assistants were underclassified or were doing the work of field assistants while being paid as labourers. The expert found also a considerable need for scientific soil correlation and for improved understanding of recent developments in soil classification. There was also an urgent need to guide the uses of soil surveys and of soil information in formulating a seven-year development plan, in planning and operating land settlements and other projects, and in strengthening the soil technology available as part of the base for continual improvements in farming practices.

The expert was enabled to make field studies of soils in all settled parts of the country, and at several places in the Interior; and to visit the field parties making soil surveys. He also studied in detail the reports of the 1961-64 soil survey project, which were available in preliminary form. He contributed an article on Soil Surveys to the Farm Journal of the Ministry of Agriculture, helped prepare material for a Farmers Leaflet on Soil Conservation, served on a Land Development Planning Committee, and helped prepare statements and maps concerning soil resources for use in the Seven-year Development Plan that was completed in September 1965. He prepared a paper on Soil Resources, accompanied by tables and a small scale general soil map. He also worked with the soil survey staff in countless informal discussions and training sessions, all of which helped to train the expert as well as the local staff.

The spirit of cooperation and the devotion to duty of members of the Soil Survey Staff is remarkable. Soil Survey work, including and perhaps especially that at the field assistant level, requires an unusual blend of intellectual capacity and skill along with hard, sweaty, physical effort, often in dust, mud, or rain, and sometimes in waist-deep water. The staff members at all levels were helpful, patient with a newcomer ignorant of the local customs, eager to grasp new ideas if they were sound, and forthright in challenging statements not supported by the facts at hand. The intellectual environment for constructive work was extremely good.

This final report deals largely with technical aspects of making, reporting, and interpreting soil surveys. An interim report on Soil Resources of Guyana, summarized from reports of the British Guiana-United Nations Soil Survey project of 1961-64 and containing a page-size map of general soil associations, was submitted separately.

The expert is grateful for the many personal courtesies that were extended to him, especially on the part of the Honourable Minister of Agriculture, the Permanent Secretary, the Permanent Assistant Secretary, the Chief Agricultural Officer and his Deputies, the Chemist, the Soil Surveyor, and the Soil Survey Assistants. Many people went out of their way to make the assignment a pleasant and productive one.

II SUMMARY AND RECOMMENDATIONS

A. Soil Survey and Related Staff.

Positions in the Soil Survey staff need to be established and filled while the people trained by soil scientists of the FAO are still available to fill them. The subprofessional staff has been remarkably loyal and productive for more than two years, even though not organized on a permanent basis.

A list of positions was recommended by the Director of Agriculture in 1962. The need to put the plan into effect was emphasized by the manager of the British Guiana-United Nations Soil Survey Project before that project closed in May, 1964. A scaled-down plan was discussed with the Acting Permanent Secretary by the Soil Surveyor and the Soil Survey Officer, FAO, in July, 1965. Early decisions on the questions are needed.

The minimum technical staff needed for soil surveys appears to be 1 professional soil surveyor, 1 senior technical assistant, and 3 technical assistants of grade I or grade II. A drafting assistant is also needed. Three subprofessional men are working, (in June 1966) but the grade and pay of two of them do not match the work being performed. One is daily paid but doing the work of a trained field assistant. A drafting assistant was employed recently and is still on probation; one more field assistant needs to be recruited. This list does not include staff for the soil laboratory, or an officer to study responses of crops on named kinds of soil. The soil survey staff suggested is a minimum one and is not adequate to conform with the practice in most countries of having soil survey field mapping done by professional people. To come closer to that goal, the staff should be strengthened, at least by appointing a second professional soil surveyor, as soon as the budget permits and a qualified candidate becomes available.

The need for graduate study and for other forms of intellectual stimulation by a small, specialized scientific staff such as that of the soil survey will be a continual problem. A new system of soil classification is coming into use, and rapid advances are being made in interpretation and use of soil surveys in several tropical countries.

A regular plan for development and training of professional and subprofessional soil survey staff is needed. A second graduate soil scientist, as already suggested, can make soil surveys, carry part of the load of interpreting soil surveys for use, and keep the work going whenever the senior soil surveyor is on leave or for any reason off duty. New field assistants should be recruited whenever a vacancy occurs. In-service training should be continued. Outside reading and study should be encouraged. Occasional field trips for joint study of soils in different parts of the country are essential.

The work to measure responses of crops to defined levels of management on named soils should be continued. A full-time staff member was named in November 1965, to do this important work. The scientists assigned to do such work should become expert in field identification of soils, if possible through actual work in a soil survey party.

A full-time person is needed to do extension work in soil management, especially in control of runoff and of soil erosion whenever sloping soils are brought into cultivation. His title might be Soil Conservation and Land Use Officer. He should not be a member of the Soil Survey Staff as it is presently organized, but might be a specialist responsible to the Director of Extension. He, too, needs to become expert in field identification of soils, and would benefit greatly if assigned to do soil survey field work for at least a few weeks during his early experience.

B. Correlation of Soils.

A procedure is recommended for scientific correlation of the soils in each area surveyed. The procedure, part of a technical guide for soil surveys, calls for review of the soil mapping units by the responsible scientist (that is, by the Soil Surveyor); study of the field maps, field notes, and analytical data: comparison with similar kinds of soil mapped in this country and elsewhere; assignment of a name to each kind of soil; classification of each kind of soil in an established international system; and a permanent record of the characteristics and qualities of each kind of soil.

C. Uses of Soil Surveys.

Effective returns on the investment of more than a million dollars in soil surveys in Guyana can be obtained only if a soil survey staff of high quality is consistently maintained. This staff and certain other specialists need to carry out the following duties.

1. Make new soil surveys according to accepted standards.

2. Study continually the reports of past soil surveys; extract and summarize information from them on short notice; to permit such study, make sure that the maps and reports are preserved in libraries and in the files.

3. Classify and correlate the soils as new soil surveys, other field studies, and laboratory analyses add to existing data on the distribution, extent, and characteristics of soils of different kinds. Part of the results of such work should be papers for publication or for presentation at scientific conferences.

4. Assemble and interpret data on responses to management of crops on named kinds of soil.

5. Provide information on soils of proposed development projects, and on implications of soil data that might influence decisions about policy or operation of land-management activities.

6. Interpret soils for the regular work of Agricultural Officers and Assistants: (1) by preparing reference materials on characteristics and performance of named kinds of soil; and (2) by making field investigations of specific areas of soil when questions come up.

III SUGGESTIONS FOR MANAGEMENT OF SOIL SURVEYS:

A. The Soil Survey and Soil Research Board.

Soil Surveys are made to find out the location and extent of significant soils; to plot soil boundaries on maps; and to find out for each kind of soil, what plants can be grown, what is needed to grow them, what will be the yield and quality, and what is needed to maintain and improve the soil itself. Modern soil surveys are useful also in certain kinds of engineering work, for location of roads and buildings and for ascertaining properties of soil materials that are to be used in roadbeds or for any kind of earthworks. Besides meeting these practical objectives, a modern soil survey adds to scientific knowledge and increases our understanding of the world in which we live.

The making and direction of soil surveys is a scientific activity that requires specialized scientific staff, and needs to be carried out by a scientific staff in one Department or Ministry. The uses of soil surveys, however, involve many of the branches of a modern government. To provide for regular communication between the makers of soil surveys and the users of soil maps and soil data in British Guiana in 1961-64, a Soil Survey Advisory Board was established in an early stage of the joint British Guiana-United Nations Special Fund Soil Survey Project of those years. When the work of that project came to an end early in 1964, members of the Board recommended and organized a permanent Soil Survey and Soil Research Board.

The Board gives the Ministry of Agriculture an opportunity to report the progress on soil surveys to representatives of other Ministries and Departments; helps the Ministry of Agriculture in setting priorities and establishing schedules of work; and aids the Soil Survey Staff in obtaining base maps, in scheduling details of the work, and in taking advantage of the scientific and technical knowledge that is available from all sources in the Government.

B. Selection of Soil Survey Areas.

Since annual capacity of the Soil Survey unit is small in relation to the large acreage of semi-detailed soil surveys that will be needed eventually, the Board advises the Ministry of Agriculture in selecting each year the areas in which new soil surveys are needed most urgently. To enable the Soil Survey staff to plan and organize the work efficiently, each area should be selected about two years before the actual field survey is to begin. That is, a programme for the current calendar year and the following one should be maintained at all times. Time is required to obtain aerial photographs and other base maps and to organize field operations. Preliminary studies of the soils may be needed in order to set up proper mapping units. If preliminary work has been done in advance on several soil surveys, adjustments in priorities can be made quickly in line with special needs if they should develop.

Soil survey areas should be chosen in relation to plans for land development or for work on some aspect of land management. Consultation with the Soil Surveyor is essential in an early stage of any plan for development of unoccupied land. If a semi-detailed soil survey has not been made, the small-scale, highly generalized soil maps already available can point the way toward areas to be favoured and those to be avoided in planning development schemes. An early exploratory investigation by the soil scientist often is a good investment. The study of available maps and the making of rapid exploratory studies should generally be followed by a semi-detailed soil survey, unless the preliminary work shows that an alternate site should be selected.

Areas selected for semi-detailed soil surveys should be of medium size - preferably between 20,000 and perhaps 75,000 acres. A project smaller than 20,000 acres is too small for efficient management; one larger than 75,000 acres can be managed efficiently but is likely to take in land for which information is not needed urgently. These limits are of course intended to suggest a guide line, not a rigid rule.

C. The Soil Survey Staff.

The Soil Survey is a scientific activity that requires peoples who have academic training of high quality in soil science, biological science, earth science, and production of crops, along with other essential skills and aptitudes. They must acquire skill in cartography and in interpretation of aerial photographs. They must be willing to do the physical work required to see soils in the field and trace out soil boundaries.

Because of the space relationships of soils and the need to observe soils in their environment, the value of a soil surveyor increases as he works professionally in one region or country year after year. Good academic training is essential, but the scientists must also work with the soils. Continuity of scientific and technical staff, and overlapping assignments whenever replacements must be made, are essential in a modern soil survey.

The Soil Survey Staff in Guyana falls short of reasonable requirements. Two years after the close of the British Guiana-United Nations Soil Survey Project, decisions are still needed regarding structure of the organization; especially on the number of positions and their grades.

In an early stage of the 1961-64 project it was decided to meet the requirements for National counterpart staff by employing only two professional soil surveyors, (later reduced to one) and by training secondary school graduates to do the highly technical work of describing soil horizons, ascertaining properties of soils by making borings and excavations, plotting soil boundaries on field maps, and preparing descriptions of soils for soil survey reports. This use of subprofessional people was forced by the lack of men with professional qualifications who could be trained to do soil mapping. The practice differs from that in most developed countries, where soil mapping is done by professional men who have had university training (19).

One professional soil surveyor and 5 subprofessional men received intensive training, under soil scientists of the Food and Agriculture Organization, in the regular soil survey work of 1961-64. One of the field assistants was sent abroad by the Government for training on a FAO Fellowship during the academic year 1963-64. The FAO expert found to his dismay at the beginning of 1965 that two of these experienced and highly qualified field assistants did not yet have the prestige of a monthly appointment, but were daily paid. The man who had returned in September 1964, after a highly successful year of university work in advanced subjects, was (and is in 1966) still in the position of Field Assistant, Grade II, temporary. To his credit, he is performing work far beyond that required in his grade; planning soil survey operations, managing field parties, assembling scientific data relevant for new soil surveys, mapping soils in the field, and interpreting soil conditions to service requests from farmers.

One difficulty was that the permanent Soil Survey organization, promised in the United Nations contract of 1961-64, had never been formally approved and placed in effect. The Director of Agriculture recommended a list of positions in 1962. The Project Manager of the FAO team emphasized the need for a permanent organization just before the British Guiana-United Nations Soil Survey Project came to an end in May, 1964. The positions needed have not yet been allocated and filled in June, 1966. Soil survey work is going forward, but only because several of the subprofessional staff members have performed beyond the requirements of their positions and the pay that they receive. Ways should be found to keep these trained men on the staff; if necessary, to arrange training for them to meet requirements for the positions.

Between 1962 and 1965 the number of professional soil surveyors listed on the organization chart was reduced from two to one. A second professional soil surveyor should be employed, and assigned to make field surveys, as soon as the budget will permit and a qualified person can be found. Willingness to make field soil surveys, in swamps and in upland bush, is essential. Two professional soil surveyors can provide continuity in the work, meet some of the obligations for interpreting soil surveys in projects ranging from National programmes to service work on individual farms, and permit orderly replacement of the senior staff member when the inevitable turnover occurs.

Late in 1965 a new staff member in the Division of Chemistry and Soils was employed to begin plot experiments to ascertain responses of crops to defined levels of management on named soils. This important position should be continued, and the work done should be arranged to strengthen but not to duplicate other investigations that deal with management of soils. Other field plot investigations were done by an agronomist of the FAO, assigned first to the Soil Survey Project of 1961-64, and later to the World Food Programme until the end of June, 1966.

D. The Need for Soil Management Research.

In most tropical countries, and perhaps especially in Guyana, progress in soil mapping and classification is somewhat ahead of the progress in gathering knowledge about how the soils perform when they are managed to produce annual crops, tree crops forage, timber trees, and other commodities. The kinds of soil in the coastal sections are known, and more than half of the potentially productive soils in those sections, but not the large peat swamps of the Northwest, have been covered by semi-detailed soil surveys. Some sample soil surveys have also been made in areas of the Interior, and many of the kinds of soil there have been defined and classified. For all the soils and especially for those in the Interior, however, not nearly enough is known about their responses to management.

Interpretation of soil surveys requires systematic knowledge of the ways in which each kind of soil responds to a reasonable combination of management practices. Management involves clearing or preparing the land, selecting the crop or the combination of useful plants, use of fertilizer, or soil amendments, drainage or irrigation if such practices are needed, control of runoff and erosion, and the other practices needed to grow, protect, and harvest crops that can be consumed or sold.

The data needed to predict performance of different soils under defined management can be obtained in two ways. Empirical observations of yields on experimental plots or on farmers' fields, must be obtained and recorded for representative soils. As a body of knowledge is thus built up, the predictions can be extended to other kinds of soil by application of our knowledge of interactions involved among soil characteristics, the needs of the crop, and the management practices.

Data from plot experiments are obtained slowly, however, and only a few soils can be tested exhaustively in this way. Investigators need to choose with care the kinds of soils that are studied in detail. The practice in many countries has been to study in too much detail the soils that are nearly level, free from stones, reasonably productive, and uniform enough to permit layout of a neat set of experimental plots. Much fewer data are available for the soils that are stony, hilly, or partly eroded, although these are the soils that must be used for large acreages of cropland and pasture.

The knowledge of soil characteristics needs to be strengthened greatly to provide a basis for predicting performance of soils. Good analytical data are currently obtained on representative soil samples, for content of sand, silt, and clay, and for reaction, organic matter, nitrogen, extractable phosphorus, extractable bases, base-exchange capacity and soluble salts. Other data needed to predict performance include the kinds of clay minerals, and such physical data as bulk density, permeability, plastic and liquid limits, and capacity to hold water that plants can obtain. Research facilities to obtain such data on representative (or "benchmark") soils are urgently needed.

E. The Need for a Soil Conservation Officer.

The expert suggested in writing to the Government on 29th January, 1966, that the Ministry of Agriculture needs a full-time Soil Conservation Officer on its staff. This officer should be competent in uses of soil maps, recognition of soils in the field, performance of crops on different soils, control of runoff and erosion, layout of contours and graded terraces, design of waterways, design and construction of ponds, and related duties. He should be competent in the selection of crops and cultural practices on nearly level soils and on sloping or steep soils. To avoid any implication that his duties might be limited to control of erosion, the title Soil Conservation and Land Use Officer is suggested. It is further suggested that he might report to the Director of Extension Work, and should have country-wide responsibility.

An Agricultural Officer well qualified to perform these duties was recruited near the end of 1965, and was assigned to work in the North West District. If he can be released from that assignment, it is believed that he could perform well the duties suggested for a Soil Conservation and Land Use Officer.

If a Soil Conservation and Land Use Officer is appointed, his orientation and training should include, if possible, several weeks of field soil survey work with a regular party, and trips with the Soil Surveyor to observe representative soils, the way they are being used, and the responses of crops grown on them.

IV TECHNICAL GUIDE FOR SOIL SURVEYS

A. Introduction:

The expert found in Guyana a Soil Survey Staff well trained in the techniques of describing, identifying, and mapping soils; somewhat less proficient in applications of the new system of soil classification; and distinctly in need of technical assistance to strengthen the concepts of soil series and other soil taxonomic units and to develop principles and a procedure for soil correlation. He also found, as is brought out elsewhere, a great need for data and procedures to make effective uses of soil surveys.

A few training sessions and many informal discussions were held to develop such ideas as the concept of an individual soil, the pedons that compose it, a kind of soil, and the taxonomic units (conceptual groups) of soils at various categoric levels; also the nature of a soil mapping unit and the fact that even though it has the name of one kind of soil, it is likely to contain inclusions of soils of other kinds.

This section contains a summary of the ideas discussed, along with others that are relevant in maintaining scientific quality of soil surveys and of soil survey interpretations. The items given for the most part do not duplicate directly the material that is in the Soil Survey Manual (17) although the statements about kinds of soil surveys, description of soil horizons, and mapping of soils have been partly summarized from that Handbook. The definitions of individual soil, kind of soil, and pedon have been largely developed since the Manual was written. The section on Designation of Soil Horizons in the Manual was changed drastically while work on the now soil classification was in progress. The main points in it are reproduced here for reference, since the reprinted pages 173-188 of the Manual have not reached many users who purchased their copies before May 1962.

The section on slope phases of soils has been written especially for application to the soils of Guyana.

The section on classification of soils contains statements of principles, a brief mention of some of the systems before 1938, a brief treatment of the classification in orders and great soil groups of 1938, and an introduction to the system that was developed by the United States Soil Survey since 1950, published in 1960 and modified somewhat in 1964. The classification in both of these widely used systems is given for soil series named in Guyana in the soil survey of 1961-65. The classification is also suggested for the soil series named in interior areas by soil scientists of the Regional Research Centre in 1957-59.

Study of the available descriptions of soil series revealed the need to cast all of them in the new format now in use for soil correlation work in the United States. Part VI of this report is a compilation of these descriptions in that standard format. The descriptions are as precise as they could be made with respect to range of characteristics and differentiae from competing series, but many of them need to be improved under those two headings as further field studies are made.

It is suggested that the set of descriptions of soil series should be furnished to every member of the Soil Survey Staff; and to every Government Officer who is interested in the characteristics of soil series and the technical distinctions that set them apart from one another.

B. Recent History of Soil Surveys in Guyana.

Rapid progress in soil surveys has been made since 1955. In 1955-56 a technical mission from the United States made detailed soil surveys of two small areas and a reconnaissance survey of the northeastern coastal plain and adjacent uplands. Processed maps and reports are available. About the same time soil surveys were made of several areas in the interior, by the Regional Research Centre of the British Caribbean. These soil surveys were published in 1958 and 1959 in three bulletins that contain soil maps and reports for five small areas, and soil studies without maps of two other areas. Some soil surveys were also made by scientists of the Ministry of Agriculture 1957-61.

Soil Surveys received great emphasis in a joint project of the Government and the United Nations Special Fund that was carried out in 1961-64 by the Food and Agriculture Organization of the United Nations. This work produced reconnaissance soil maps at a scale of 1:500,000 of the entire country except about 10 percent not covered by aerial photographs; and semi-detailed soil surveys of three large areas. Soil mapping units on the reconnaissance soil survey are soil associations, which on that survey are broad patterns of geographically associated soils named at the level of great soil groups. The report contains descriptions of the mapping units, and also descriptions of the profiles of representatives soils in most of the great groups.

The semi-detailed soil surveys made by the joint project cover the Canje Area, 979,000 acres; the Mahaica-Mahaicony-Abary Area, 469,700 acres; and the Ebini-Ituni-Kwakwani Area, 597,000 acres. Soil maps were reproduced at a scale of 1:50,000. Mapping units are soil types or phases of soil types. Reports contain a description of each mapping unit, suggestions for use and management of the soils, a grouping of the soils in capability classes and subclasses, ratings of suitability of the soils for various crops, and detailed descriptions of representative soil profiles.

Soil surveys of several areas, ranging in size from 1000 acres to more than 50,000 acres, have been made by the Soil Survey Staff in the Ministry of Agriculture since the joint soil survey project came to an end early in 1964. This work is continuing. Results are recorded in soil maps and reports, which are distributed to the persons or departments concerned and are also preserved for future uses.

C. Purposes and Uses of Soil Surveys.

Soil surveys are made for applied and for fundamental objectives. Practical objectives in agriculture and forestry justify the cost of the work. The major practical objectives are to map the distribution of soils, and to find answers to four questions: On each kind of soil, what kinds of plants can best be grown, what is needed to grow them, what will be the yields and quality, and what will happen to the soil if they are grown? Agricultural soil maps are useful also in some kinds of engineering work, wherever soils are used for roadbeds, for foundations, or as a source of materials for earthworks.

Experience has shown that a soil survey meets these applied objectives best if it meets at the same time certain fundamental objectives. Every good soil survey expands our knowledge and understanding of the world around us. A soil survey that defines and maps kinds of soil, according to sound scientific principles, meets the applied objectives better than one made for a more narrow purpose or by short-cut methods. Moreover, a sound soil survey can be re-interpreted from time to time to meet new or changing practical objectives.

Three steps in making and using a soil survey can be outlined here in brief form. They are given in greater detail in the parts of this guide that follow. The steps can be listed in order, although more than one must take place at the same time. Work on each of them must be constantly reviewed and perhaps modified as work goes forward on the others.

First, soil scientists need to define kinds of soils and classify them. In a new area, this has to be done tentatively at first, and the concepts have to be tested. If the kinds of soil in an area are already known and have been defined in writing, the soil scientists can proceed rapidly with the next step.

The second step is to plot the boundaries of different soils on a suitable map. This step requires the identification and description of soil mapping units. These operations are treated in more detail in another section; at this point it can be mentioned that a mapping unit at any practicable scale is likely to have in it inclusions of soils other than the main kind for which it is named. The surveyor must see many borings, study the soils in the field, and plot the soil boundaries. This stage of the work is sometimes disagreeable and occasionally hazardous.

In the third step, soil scientists and others determine the performance of each kind of soil when it is used for agriculture, forestry, engineering, or some other purpose. Suitable crops, yields of crops under defined management and the need for erosion-control practices on each kind of soil are some of the major kinds of data needed to plan efficient and profitable agriculture. Obviously soil scientists alone cannot obtain all the information needed. The findings of men in fields such as agronomy and horticulture must be joined with results of the soil scientists' work of identification, mapping, characterization, and classification of soils. Much of the knowledge about performance of soils must be based on empirical findings; that is, on observations of what happened when a soil was used and treated in a certain way. Results needed for soil survey interpretation are obtained slowly, at the best. It is easy to allow the interpretive steps to lag behind the production of soil maps, and of the accompanying descriptions and characterization data. To make good use of any soil map, however, information about the performance of each kind of soil must be obtained, summarized, and kept available.

Functions of soil surveys were grouped under five major headings, in a study made in the United States about 1952. The major headings are:

a. Soil use and management

b. Land Valuation

c. Engineering.

d. Planning and conduct of research.

e. General education on natural resources.

In Guyana at present, the most important functions appear to fall under the first and fourth headings. Methods of the use, management, and conservation of soils need to be improved; in order to do these things further research is needed on the major soils and on many soil-related questions. It is likely that uses of soil surveys under the other three headings will increase substantially in the future.

D. Some Definitions Useful in Soil Surveys.

Soil in a general sense is the collection of natural bodies on the surface of the earth, that were formed from mineral or organic matter, contain living organisms, and support or are capable of supporting plants.

The foregoing definition of soil is satisfactory for most purposes although not for all. A fully satisfactory general definition is difficult to write. Certain man-made mixtures of sand, clay, and organic matter, for example, support growing plants and are properly called soils, but might not be regarded as natural bodies. The definition is generally adequate, however, as a basis for the examination, description, classification, and mapping of different kinds of soil.

Soil in the general sense is composed of an uncounted number of individual soils, distributed all over the land surface of the earth. We study the characteristics of individual soils, and then define kinds of soil which we call soil types and phases of soil types. We group those primary kinds of soils into soil series and into higher units of classification.

An individual soil is one body of one kind of soil. It has area and thickness. Its outer boundary as a rule is irregular. It is surrounded by soils of other kinds, or by bodies of material other than soil, such as water or rock outcrops. It is bounded above by the atmosphere, and often has on it a layer of plant cover or of plant residues. Its lower boundary is the hard rock or the unconsolidated geological material on which it rests. Its shape is that of the land surface that it makes up, and may be nearly level, sloping or steep; also concave or convex, smooth or irregular, and so on. It contains, throughout its extent, horizons or layers that are similar (within defined limits) in arrangement and in characteristics, Another detached but closely similar body of soil is another individual soil of the same kind.

A kind of soil consists of all the individual soils, wherever they are, that have characteristics within a defined range. For scientific soil classification, and for all but the most detailed practical applications of soil science, we define, study, describe, classify, and predict the performance of kinds of soil rather than of individual soils. We try to make our definition of a kind of soil specific enough that on all the individual soils of that kind the performance of growing plants under similar treatment is nearly the same. A kind of soil is also called a taxonomic unit.

For the benefit of those who read soil literature, a term introduced in 1960, the pedon, is also defined here. A pedon (pronounced to rhyme with head-on) is the smallest area (and volume) of a soil that permits study of the full range of characteristics of that soil. It is large enough to study the roots of characteristic vegetation and the range of variability in soil horizons. It is never less than 1 square meter in extent; and seldom more than 10 square meters. A few soils contain intermittent or cyclic features that recur at intervals along or in reference to a line drawn parallel to the surface in any direction. An example is a discontinuous B horizon. In such soils a pedon includes more than one-half the cycle and is large enough to cover the full range of horizon variability. Each individual soil thus consists of at least one pedon, or more often of a large number of contiguous pedons that resemble one another. The term polypedon, meaning an individual soil as here defined, is likely to appear with increasing frequency in technical soil literature. Some scientists also prefer the term soil individual, and use it with the same meaning as individual soil is used here.

The soil series: A soil series is a kind of soil; that is, a taxonomic unit. It consists of individual soils that have similar characteristics, within defined limits, except for texture of the surface soil; and that were developed from a particular type of parent material. Soils of one series have similar horizons, and a similar arrangement of horizons in the soil profile. Differentiating characteristics that set one soil series apart from others are morphological features of the soil profile; mainly the kind, thickness, and arrangement of horizons, and their structure, colour, texture (except texture of the A horizon or the plow layer), reaction, consistence, content of carbonates and other salts, content of humus, and mineralogical composition.

The concept of the soil series is an important one in all aspects of the classification and mapping of soils. The concept of the soil series as a taxonomic unit (unit of classification) remained unchanged when a new system of soil classification was created by soil scientists of the United States, beginning in 1951. Definitions of certain soil series need to be changed from time to time, and the limits of some need to be made more precise to meet requirements of the new classification, but the concept remains unchanged. Soil series are grouped into higher categories, which are families, great soil groups, suborders, and orders in the old classification; and families, subgroups, groups, suborders, and orders in the new one.

A soil type is a group of soils, within one series, that have surface soil of the same textural class. Generally the type is named according to texture of the A horizon; but if the A horizon is thin, the practice in most countries is to consider the soil to an average plow depth of about 6 inches even if it has not been plowed or cultivated.

Soil series and types form the basis for naming kinds of soil. Each soil series is given a geographical name, generally the name of a village or a natural feature near the place where a representative soil of that series can be seen. The names Brandwagt, Everton, and Wauna, for example, have been given to soil series in Guyana. The soil series name, plus the texture of the surface layer, forms the name of a soil type. Examples are Everton silty clay and Wauna coarse sandy loam. Most of the mapping units of semi-detailed or detailed soil surveys are soil types or phases of soil types.

A soil phase is a subdivision of a soil taxonomic unit, at any level in the system of classification, on the basis of characteristics that are important under the present or prospective cultural environment (when the soils are used) but have little influence on behaviour of the soil in its natural environment. Examples of soil phases are Wauna coarse sandy loam, 8 to 15 percent slopes, and Corentyne clay, saline phase. Stony phases, rocky phases, gravelly phases, shallow phases, and low or wet phases of different soils can also be recognized.

A soil mapping unit is a body that is mainly one kind of soil or that contains a defined pattern of soils of more than one kind; and that is represented, by an enclosing boundary and an identifying symbol, on a soil map. Many of the mapping units on a detailed or semi-detailed soil map are named for a single kind of soil, usually a soil type or a phase of a soil type. Most soil mapping units on a practicable scale, however, contain small bodies of one or more kinds of soil other than the one for which the mapping unit is named. Such small unmapped areas are called inclusions. It will be emphasized under Mapping of Soils that a description of each mapping unit, including the size, proportion, and nature of the inclusions, is an important part of every soil survey.

If a soil mapping unit contains two or more kinds of soil, and each kind occupies more than about 15 percent of the total area, it is named as a complex rather than as a single kind of soil. Soil complexes are mapped on detailed or semi-detailed soil surveys. On a map that is made by reconnaissance methods or by generalization, all the mapping units are likely to consist of patterns of soils rather than single kinds, and are called soil associations. A soil association is a group of geographically contiguous but often contrasting soils, having a characteristic but not a uniform pattern.

Soil mapping units are discussed further in the section, Mapping of Soils.

E. Kinds of Soil Surveys and Soil Maps.

Soil maps obtained by plotting soil boundaries in the field are classified as detailed, semi-detailed, and reconnaissance. Soil maps obtained partly or wholly by making abstractions or inferences from existing soil maps or other maps are called generalized or schematic soil maps. Another kind of soil map, called an exploratory soil map, is also defined. Although scale of mapping is mentioned in the definitions that follow, the kinds of soil surveys are distinguished by the manner in which soil boundaries are observed and plotted, rather than by scale.

Detailed soil maps: On a detailed soil map boundaries of soil mapping units are plotted in the detail required to show the areas significant in prevailing or expected use of the land. Boundaries between mapping units are plotted from observations made throughout their course. The scale of mapping is usually at least 1:15,000, and may be much larger. In Guyana, about the only detailed soil maps that have been made, according to this definition, are those of some areas to be used for experimental plots.

Semi-detailed soil maps: On a semi-detailed soil map, boundaries of mapping units are observed throughout their course if the land is open, but might be extended between observed lines if the land is covered with bush or trees. As in detailed soil surveys, the aim is to show the boundaries of mapping units significant in land use. The percentage of inclusions in some mapping units, and the number of mapping units named as complexes rather than as single kinds of soils, can be somewhat greater than in detailed soil surveys. Scale of mapping and of reproduction often ranges from about 1:20,000 to 1:60,000.

Reconnaissance soil maps: On a reconnaissance soil survey the boundaries between soil mapping units are plotted from observations made at intervals rather than throughout their whole course. Intensity of coverage and scale of mapping vary widely, the scale from 1:30,000 to as small as 1:500,000. In the reconnaissance soil survey of Guyana that was made as part of the British Guiana-United Nations Special Fund Soil Survey Project in 1961-64, most boundaries of mapping units were plotted after stereoscopic study of aerial photographs by a scientist trained in geomorphology, soil science, and interpretation of aerial photographs. The boundaries were checked and corrected in extensive field studies, and representative soils in each mapping unit were studied in the field, described, and sampled.

Mapping units on any reconnaissance soil survey are necessarily associations of soils rather than single kinds. On the reconnaissance soil maps of Guyana, reproduced at a scale of 1:500,000, mapping units are associations of great soil groups. Descriptions of the mapping units give the range of major soil characteristics, geological material, physiographic position, and relief.

Generalized soil maps: A generalized soil map is one made by generalizing from more detailed maps. It is prepared by generalization of other maps rather than by reconnaissance field work, but when completed has the same characteristics as a reconnaissance soil map. Either a generalized soil map or a reconnaissance soil map might carry the title "General Soil Map."

Schematic soil maps: A schematic soil map is a small-scale map of soil associations, made by estimating the soil patterns from data available from topographic maps, aerial photographs, and all that can be learned from maps or other sources about climate, vegetation, geology, and land forms. A schematic soil map is often prepared in an early stage of the study of an area, and is replaced by a reconnaissance map or a generalized map when enough data become available.

F. Examination and Description of Soils.

Before soils can be mapped, a mapping legend is needed. The mapping legend contains a symbol and a description for each mapping unit. The description names the dominant kind of soil and refers to the accepted description of it; it also names and refers to accepted descriptions of any other kinds of soil that are present as inclusions, and gives the approximate proportion of each. The description of a mapping unit gives other information that will help the soil mapper or the user of a soil map; especially the physiographic position, land form, shape of slope, characteristic vegetation, patterns of drainage, and the pattern in which this mapping unit occurs in relation to those around it.

The description of a kind of soil is written by the soil survey party in at least four stages. One is the description, by horizons, of several soil profiles. Another is the description of features outside the soil profile, wherever a profile description is obtained. Then the description of a representative profile is selected. Finally, from the accumulated descriptions and observations, a description of the kind of soil, including its range of characteristics is prepared.

The description of a kind of soil contains observed facts about horizons in the profile, observed facts of the other characteristics above, around and under the profile, and inferences about certain soil qualities that cannot be observed directly, such as class of natural soil drainage, permeability, water holding capacity, and erodibility.

<u>The need for standard terminology</u>: Standard terminology must be used if descriptions of soils are to be useful to other workers or even to the person who writes them. Many words must be used that are part of the common speech. Generally, in common speech the words have been used with variable meaning or with meaning more general than is desirable in soil science. A standard terminology is desirable, and has been established in the Soil Survey Manual (17).

<u>The need for reproducible observations</u>: Adequate objective descriptions of soils should be reproducible by different workers. Closely similar descriptions of a soil profile should be obtained, for example, if two or more persons describe it or if the same person describes it more than once. It is not enough to have adequate standards and terminology, although these are essential. Men must be trained to observe the characteristics and to use the standard terms, and must check their judgement from time to time with other competent scientists.

<u>Description of the site and environment</u>:

Introductory information on the site sampled is needed along with every description for soil profile. It is suggested that the following details should be given.

a. Profile number
b. Date
c. Soil name
d. Classification in higher categories
e. Location
f. Elevation
g. Relief (terms and definitions as in Soil Survey Manual)
h. Slope (use classes and names from this Report)
i. Vegetation, or present land use
j. Climate (give best data available, or refer to available records)

Certain general information about the soil should be recorded wherever a profile is described or sampled. The principal items are:

a. Kind of geological material under the soil profile. Indicate whether you believe it to be similar to the parent material of all or part of the profile.
b. Physiographic position or land form.
c. Soil drainage (classes are defined in the Soil Survey Manual).
d. Depth of the ground water table.
e. Surface stoniness (classes are in Soil Survey Manual).
f. Rockiness (classes are in Soil Survey Manual)
g. Presence of visible salts.

Descriptions of soil profiles:

The following outline provides a check list. Definitions of the terms are given in greater detail in the Soil Survey Manual. Each horizon is to be described in standard terminology. The following items should be described if they are applicable.

Horizon: Designation in standard nomenclature; but remember that the horizon designation is an opinion, not a fact, and able scientists do not always agree.

Depth: In inches or centimeters, from top of the A1 if a mineral soil.

Thickness: Give average and range.

Boundary: Nature of lower boundary (1) as to distinctness, as abrupt, clear, gradual, or diffuse; and (2) according to shape, as smooth, wavy, irregular, or broken.

Colour: Record Munsell coordinates and also the name. Record colour where practicable of coatings, on the peds, and of principal mottles. Describe pattern of mottling.

Mottling : Give Munsell notations or adjective equivalents. Note pattern, especially abundance, as few, common, or many; size, as fine, medium, or coarse; and contrast, as faint, distinct, or prominent.

Texture: Name the textural class (see Soil Survey Manual).

Structure: Much practice is needed to describe soil structure. Identify the class, which refers to size, as very fine, fine, medium, coarse, and very coarse. Actual dimensions vary with the type of structure. Identify also the grade, or distinctness, as structureless, weak, moderate, or strong. Identify the type, or form, as platy, prismatic, columnar, blocky, subangular blocky, angular blocky, granular, or crumb; structureless forms are single grain or massive.

Coatings on structural aggregates (peds) have been given attention by pedologists in recent years. The coatings have been called clay films, clay skins, and cutans. The term cutans is on its way to acceptance and is preferred by many scientists because it implies neither the composition nor the mode of formation. The extent and thickness of cutans can be described after peds are examined with a hand lens. Terms for extent (quantity) are:

Patchy: Small scattered patches of cutan on ped faces or as linings in pores and channels.

Broken: Cutans cover much but not all of ped faces, or line most but not all pores and channels.

Terms used to describe thickness of cutans are the following:

Thin: Fine sand grains are readily apparent in the cutans, bridges between grains are weak, and the thickness is microscopic.

Moderately thick: Fine sand grains are enveloped in the cutans and their outlines are indistinct.

Thick: Surfaces of cutans are smooth, showing no outlines of fine sand grains; strong bridges between larger grains.

Nature of cutans has been classified by Brewer (2) who listed the following classification. The classes at present cannot be distinguished easily by observations in the field.

Pure clay minerals (rare).
Clay minerals with iron oxides and hydroxides.
Clay minerals with organic matter.
Sesquioxides.
Manganese oxides or hydroxides.
Soluble salts (carbonates, sulphates, chlorides, etc.)
Silica.

Absence of cutans should be noted in descriptions of soils in which their presence might be a diagnostic feature for classification, to show that the item has not been overlooked.

Consistence: When wet, grades of consistence are non-sticky, slightly sticky, sticky, or very sticky; also non plastic, slightly plastic, plastic, or very plastic. Consistence when moist is loose, very friable, friable, firm, very firm, or extremely firm. When dry the terms for consistence are loose, soft, slightly hard, hard or very hard. Describe also the cementations if present, as weakly cemented, strongly cemented, or indurated.

Reaction: Give the pH value. If soil effervesces with HCI, indicate whether the effervescence is slight, strong, or violent.

Special formations: If concretions or nodules are present, note their abundance, size, and probable nature. Principal kinds of nodules are those formed from lime, iron, and manganese compounds. Hard nodules are called durinodes in literature of the new soil classification.

Indurated (cemented) layers, called pans, are present in some soils. Indicate the probable kind of cementation, which may be by iron, organic matter, silica, lime, or by combinations of these substances.

Non-indurated pans may be claypan, with high clay content and a more or less abrupt boundary separating it from the overlying horizon; or fragipan, which is compact and is brittle when dry or slightly moist, but soft when wet.

Roots: Conventions for describing roots and pores are outlined here in some detail, since detailed specifications have been developed since the Soil Survey Manual was printed and are not given there.

The significance of distribution of roots varies from one soil profile to another; as a rule the size and number of roots in each horizon should be noted. Size classes are the same as those for granular peds in describing soil structure, namely:

Very fine: Less than 1 mm in diameter.

Fine: 1 - 2 mm.

Medium: 2 - 5 mm.

Coarse: more than 5 mm.

Descriptive terms for number of roots are few, common and many. Very few and very many can be added if such a degree of precision seems attainable. Quantitative limits that have been used by some soil scientists are:

Few: 1 to 3 per square inch exposed.

Common: 4 to 14 per square inch.

Many: More than 14 per square inch.

Pores: The following terms were suggested by W.M. Johnson in 1960, and are widely accepted and used. Items to be described are abundance, size, continuity, orientation (if tubular), distribution within horizons, and morphology of individual pores.

Abundance:

Few: 1 to 3 per square inch of surface (1 to 50 per square decimeter)

Common: 4 to 14 per square inch (51 to 200 per square decimeter)

Many: More than 14 per square inch (200 per square decimeter).

Size (diameter classes):

Micro: less than 0.075 mm.

Very fine: 0.075 to 1 mm.

Fine: 1 to 2 mm.

Medium: 2 to 5 mm.

Coarse: More than 5 mm.

Continuity:

Continuous: Individual pores extend through the horizons.

Discontinuous: Individual pores extend only part way through the horizon.

Orientation (applied to tubular pores)

Vertical: Most of the pores are oriented vertically, or more nearly vertically than diagonally.

Horizontal: Most of the pores are oriented horizontally, or more nearly horizontally than diagonally.

Oblique: Most of the pores are oriented at an angle of 45 degrees to the vertical, or more nearly diagonally than horizontally or vertically.

Random: Pores are oriented in all directions, and it is impossible to say that vertical, horizontal, or oblique orientation is dominant.

Distribution within horizons:

Inped: Most pores are within the peds.

Outped: Most of the pores are between ped faces; that is, along the interfaces between adjacent peds.

Morphology of individual pores:

Vesicular: Approximately spherical or ellipsoidal in shape, not appreciably elongated in any direction.

Interstitial: Irregular in shape, with faces that are curved inward, bounded by curved or angular surfaces of adjacent mineral grains, or peds, or both.

Tubular: More or less cylindical in shape; roughly circular in cross-section but greatly elongated along the third axis.

The terms for morphology are modified as follows: Tubular pores are described as simple if not branched, dendritic if they are branched like roots of plants. Tubular and interstitial pores are described as open or closed; they are closed if both ends are sealed off by mineral or organic-mineral particles.

<u>Designations for soil horizons and layers:</u>

The section that follows has been abstracted from the first part of Chapter 5 in the publication Soil Classification, A Comprehensive System, 7th Approximation, by the Soil Survey Staff, Soil Conservation Service, United States Department of Agriculture, August, 1960, and important amendments in 1964 (12, 18). The part reproduced here serves as an outline and check list but does not contain full definitions and explanations of the terms. It differs in several details from pages 173-188 in most of the bound copies of the Soil Survey Manual that are in circulation in 1966; reprints of those pages were made available in 1962. For details, refer either to the publication cited or to the printed supplement to the Soil Survey Manual issued May, 1962, replacing pages 173-188.

The following statements, abridged from the publication on Soil Classification, have particular significance for the soil scientist who must work mostly on his own or in consultation with a few colleagues.

Each horizon or layer designation is merely a symbol indicating the considered judgement of the person describing the soil. This implies that each symbol indicates merely an estimate, not a proven fact. It implies that when reading a symbol one must reconstruct mentally the character of the parent material, for this was done when the designation was assigned. The parent material of the horizon in question, not the material in the horizon or layer designated by the symbol C, is used as the basis of comparison. (Quoted in part only. This compiler believes the meaning has not been affected by omissions).

Conventions in use of symbols:

1. Capital letter symbols used to designate soil horizons are O, A, B, C, and R. They indicate dominant kinds of departures from the assumed parent material of the horizon designated. More than one kind of departure may be indicated by a single capital letter.

2. Horizons, O, A, and B can be subdivided by use of Arabic numerals. Combined symbols thus obtained, O1, O2, A1, A2, A3, B1, B2, and B3, indicate specific kinds of the master horizons, or transitional horizons. Each is used always with the same meaning.

3. Lower case letters are used as suffixes to indicate subordinate departures from the assumed parent material or to indicate departures from the definition assigned to the symbol O, A, B, or C. These suffixes are named and defined. They follow the arabic number in the letter-number combined symbols discussed under item 2, or they may follow the capital letters if a major horizon is not subdivided. Examples are A2g, B3ca, or Bt. The letter p is used only with capital letter A, not with A1 or A2.

4. Vertical subdivisions of any of the eight kinds of horizons named in item 2, or of the C horizon, are indicated by consecutive arabic numbers, without consistence in meaning beyond the fact that we have made a subdivision. Examples are C1, C2, Ap1, Ap2, B21, B22, and B23.

5. Roman numerals are prefixed to the designations of master horizons or layers to indicate lithologic discontinuities either within or below the solum. The uppermost material is not numbered; others are numbered II, III, and so on. For example, a sequence might be A2, B1, II B2, II B3, II C1, and III C2.

6. An illuvial horizon, together with its overlying eluvial horizon if one is present, is called a sequum. If more than one sequum is present, the lower one is given A and B designations with a prime accent, as A'2, B'2. For a buried soil, however, the descriptive lower case letter b is used, not the prime accent.

Master horizons and layers:

O	An organic horizon of a mineral soil.
O1	An organic horizon in which essentially the original form of most vegetative matter is visible to the naked eye.
O2	A mineral horizon in which the original form cannot be recognized with the naked eye.
A	A mineral horizon containing organic matter, or eluviated.
A1	A mineral horizon, at the surface, which contains humified organic matter.
A2	A mineral horizon that has lost clay, iron, or aluminium, with resultant concentration of quartz or other resistant minerals.

A3 A horizon transitional between A and B but more like A.

AB A horizon transitional between A and B, upper part like A and lower part like B, but the parts cannot be conveniently separated.

A and B A horizon that would qualify for A2 except for included parts, less than 50 percent of the volume, that qualify for B.

AC A horizon transitional between A and C, having properties of both, but not dominated by property characteristics of either.

B A horizon dominated by (1) an illuvial concentration of silicate clay, iron, aluminium, or humus, alone or in combination; (2) a residual concentration of sesquioxides, or silicate clays, alone or mixed, that has formed by means other than removal of carbonates or more soluble salts; (3) coatings of sesquioxides, or (4) an alteration of material that obliterates original rock structure; forms silicate clays, oxides, or both; and forms granular, prismatic or blocky structure if changes in volume accompany changes in moisture content.

B1 A transitional horizon, more like B than A.

B and A A horizon containing both B and A but more than 50 percent B.

B2 A horizon without characteristics transitional to an overlying A or an underlying C or R horizon.

B3 A horizon transitional between B and C or R, but more like B, and under an overlying B2 horizon.

C A mineral horizon or layer, not bedrock, relatively little affected by pedogenic processes. It is not presumed to be either like or unlike the parent material of any overlying A or B horizon.

R Consolidated bedrock. Use a Roman numeral prefix if presumed to be unlike the parent material of the overlying horizon or layer.

Symbols to indicate departures or subordinate items (see item 3 under Conventions in use of symbols.)

b Buried soil horizon

ca Accumulation of carbonates, commonly of calcium

cs Accumulation of calcium sulphate

cn Accumulation of concretions or hard concretionary modules

f Frozen soil

g Strong gleying

h Illuvial humus

ir Illuvial iron

m Strong cementation, induration

p Plowing or other disturbance

sa Accumulation of salts more soluble than calcium sulphate.

si Cementation by siliceous material (applied only to c)

sim Same as si but cementation is continuous

t Illuvial clay

x Fragipan; (a firm, brittle, dense horizon) examples, A2x, Bx, or Clx.

Note that x can be applied to B without an arabic numeral.

G. Mapping of Soils

This section deals with mapping of soils, which involves construction of a mapping legend, testing the mapping legend, examination of soils, plotting of soil boundaries, field reviews of the concepts of mapping units, and accurate description of each kind of mapping unit. Although correlation of soils is discussed in another section it must be emphasized that the processes of constructing a mapping legend, mapping soils, describing soils, and correlating soils cannot be carried on separately. All the knowledge that can be obtained, about soils in the area and their relations to soils elsewhere, must be utilized in all stages of a soil survey.

Construction of a mapping legend: In an area of nearly level soils, as in the coastal plain, the legend is mainly a list of the soil types observed in preliminary studies of the area, and those likely to be associated in the same landscape. Names of mapping units generally are soil types, although peaty phases, silty overwashed phases, low phases, or other phases of some of the types might be recognized.

In an area of sloping to steep soils the process is similar but more involved. Soil types are listed, but most of the mapping units of a semi-detailed soil survey need to be named as phases of the soil types. Slope phases are established, that are significant in using the soils and controlling runoff, by making suitable combinations, within each soil type, of the six slope classes listed in the next section. Stony phases, rocky phases, and any other phases needed to make a useful soil map are established at this stage, or whenever they are found to be significant as the soil mapping proceeds.

Most mapping units, although named for one kind of soil, contain within their boundary inclusions of one or more other kinds of soil. Examples are small depressions or wet spots too small to be mapped separately, or a narrow flood plain, only a few feet wide, along a stream in sloping or rolling terrain. If the inclusions occupy less than about 15 percent of a delineated area, they are not recognized in the name of the mapping unit, but they need to be described accurately. Inclusions are bodies of another kind of soil, too small to be shown as separate mapping units at the scale of the soil map.

The Officer responsible for scientific aspects of a new soil survey takes to the field copies of the current descriptions of recognized soil series. Descriptions according to the concepts of 1966 and the information available in that year make up Part VI of this report. Each new soil survey adds new data, and the Soil Surveyor adds descriptions of new series or changes descriptions of established series from time to time.

The party chief or other responsible officer examines representative soils in the field, determines the soil series in which each observed soil should be classified observes texture of the surface soil and thus names the soil type, and observes the soil characteristics that form the basis for significant phases of that soil type. In line with established practice in naming soils and assigning map symbols, he lists the name and a map symbol for each significant mapping unit likely to be encountered on that soil survey.

At this stage a description of each soil mapping unit is prepared, for use during the survey by each member of the field party. Characteristics of established soil series need not be repeated, but the ranges allowed in each type and phase and the basis for differentiating each kind of soil should be clearly stated. The nature and extent of allowable inclusions in each mapping unit should be stated. If any of the mapping units are named complexes of more than one kind of soil, the proportions of each, and the kind and amount of allowable inclusions of other kinds of soil, should be part of the description.

The list of mapping symbols and the descriptions of mapping units make up the descriptive legend. A specific descriptive legend should be prepared for each soil survey. If any member of the field party finds that a new soil symbol, for any type, phase, or complex needs to be added to the legend, he discusses the need with the party chief. If the party chief agrees, the new symbol and description, including differentiating features from the kinds of soil already recognized, are added to the description legend.

Each kind of soil encountered on the survey is identified with a symbol from the approved descriptive legend for that survey.

The descriptive legend is expanded and made specific, by means of field notes, as the soil survey is carried on. A good set of field notes permits rapid writing of a good soil survey report when the field work is completed.

<u>Testing the mapping legend:</u>

The legend is tested in three primary ways as the work progresses (9).

1. Are the soil units mappable? Some clear and distinct taxonomic soil units occur in such small areas that they cannot be shown separately on maps. These units must be combined with their unlike geographic associates into complexes as mapping units.

2. Does the legend have a clear place in it for each kind of soil found in the field? If it is difficult (intellectually, not necessarily physically) to distinguish one kind of soil from another, the chances are that the two definitions do not meet at a logical intellectual boundary in relation to the genesis of the soils. It is possible, too, that some kinds of soil are being found in mapping that have yet to be defined for the legend.

3. Can predictions about performance of the many areas of each kind of soil be made consistently and accurately? If areas of the same kind of soil have significantly different responses to management, perhaps the mapping units are too broadly defined. If soils mapped by different symbols have identical responses, perhaps some mapping units are too narrowly defined. Before the party chief decides to combine mapping units, however, he must be reasonably certain that the soils do not have obvious genetic differences, or that differences in response under important uses cannot be expected.

<u>Examination of soils:</u> Soils of course are examined in many places, in pits as well as in borings, while the map legend is being constructed. As soon as a fairly complete legend has been made, systematic examination and mapping of the soils begins. The object is to find the boundaries between different soil mapping units and to plot the boundaries on the map.

If the terrain is level or nearly so, about the only satisfactory method is to lay out lines in a regular pattern, cut the bush to permit access if that is necessary, make borings along the lines at specified intervals, and make further borings at closer intervals or between lines wherever they are needed to establish the location of a soil boundary or a transition zone.

If the terrain is rolling or hilly, and if accurate, large scale aerial photographs or topographic maps are available, traverses on some pattern other than a regular grid might be advisable. The mapper must know his location accurately at all times. He should plan to examine borings along the top of each ridge, on the side slopes, on the benches and colluvial slopes, on the flood plains and terraces, and in any wet spots or other spots that might have in them mappable areas of distinctive soil. If regular lines must be walked in order to know the location, they should if practicable be laid out approximately at a right angle to some of the main streams or drainageways.

Although many decisions in mapping soils can be made after examination of auger borings, some soil profiles must be studied also, in pits or other excavations. Even in routine mapping of soils, an 18-inch tiling spade permits easy access to the subsurface soil and upper subsoil, and reveals details about colour and structure of the undisturbed soil that are obliterated when soil is brought up with an auger.

Selection of slope phases: Slope of a soil influences greatly the speed, and hence the cutting power and carrying power of runoff water. Steepness (gradient) of slope is measured in degrees or in percent. Percent of slope is the relation of vertical drop to horizontal distance. A slope of 1 to 1, which is a 45-degree angle, is a slope of 100 percent. The percent of slope is the tangent of the angle that the sloping line or surface makes with a horizontal one, multiplied by 100.

Since slope is an important characteristic that affects use of any soil, slope phases of soils are defined and mapped. If a soil type is nearly level throughout its extent there is of course no need to divide it into slope phases.

Many soil types, however, have a range of slope wide enough to cause significant differences in the risk of erosion and in the need for conservation practices when the soil is cultivated. For those soils, slope is a characteristic that must be considered along with all the others when the soil is described, classified, and mapped, and when its performance is evaluated or predicted.

As with other important soil characteristics, the relative significance of slope depends on other characteristics of the soil. A permeable soil that is composed primarily of the oxides of iron and aluminium has stable structure, and is not subject to much erosion, even if the slope is 20 percent or more; but a sandy loam surface soil underlain by moderately or slowly permeable subsoil erodes significantly on a slope of only 3 or 4 percent if it is exposed to a hard rain without protective cover.

Slope gradient can be measured and observed in the field, as a basis for mapping slope phases of soils. Other characteristics of slope, especially the shape, length, pattern, and direction, need to be observed and described. In practice, the soil scientist describes relief of the terrain as a whole as well as that of each kind of soil within it.

The significant ranges in slope gradient are determined for each soil mapping unit. Ideally, since the significance of slope depends on other soil characteristics, the limits of slope phases should be chosen specifically for each soil type. If this were to be done, however, and different slope classes were set up for each kind of soil, the result could be a confusing mixture, difficult to remember by the soil mapper or by the user of soil maps. Moreover, data on erodibility and other soil qualities are not available with the degree of precision that would be needed to establish or to use such a variety of slope classes.

A single set of six slope classes therefore has been established for all the soils of Guyana, based on observations of sloping and eroded soils at several places. It does not follow, however, that six slope phases are needed for the mapping units of every upland soil type. For some soil types, all six slope phases are needed; for others, two slope phases are enough. The significant slope phases of any soil type are established after study of the six slope classes, but combinations are made to arrive at a reasonable number of significant slope phases for a particular soil type.

The six classes of slope and description terms to designate them, where appropriate, are:

A.	0 to 3 percent;	nearly level
B.	3 to 8 percent;	gently sloping
C.	8 to 15 percent;	sloping (or moderately sloping)
D.	15 to 25 percent;	moderately steep
E.	25 to 40 percent;	steep
F.	40 percent or more;	very steep

The classes listed are combined when setting up slope phases as mapping units, so as to classify and map only the phases of a soil type that have significance. For example, if the Wauna sandy loam or the Arakaka silt loam is to be used for crops, all six slope phases of each should be mapped and described as a basis for planning soil conservation farming. In contrast, a stony Lithosol, not suited for cultivation even if gently sloping, might be divided into only two slope phases, one less than 25 percent and one more than 25 percent. Also in mapping Tiwiwid sand (deep white sand) two slope phases are enough, but the most useful break is made at 15 percent. In this way the useful slope phases of each soil type are arrived at.

Plotting of soil boundaries: Members of the soil survey party plot soil boundaries, on an aerial photograph or other base map, in the field as the work proceeds. The location of each boundary is learned from studies of borings and excavations; from observations of the slopes, land forms, vegetation, rocks, drainage patterns, and other features, and from study of the aerial photographs. Large-scale, recent aerial photographs, taken with standard overlap to permit stereoscopic study, are essential for a modern soil survey. Boundaries drawn in tenative fashion from study of the photographs, however, must be checked by observations of the soils.

The soil mappers show important place names, schools, churches, main roads, and other features that will help users of the maps find locations and interpret the soil boundaries.

Field notes and reviews add to the concepts of mapping units as the work proceeds. The soil scientist from headquarters, backed whenever feasible by consultants who know the soils of this country or of other countries, reviews soil surveys in the field for five reasons:

1. To give guidance on the difficult problem of soil description, soil classification, and the identification of soil boundaries.

2. To check field notes and descriptive legends.

3. To check soil maps for accuracy and for conformity to the legend.

4. To give tentative names to the soils and determine the probable classification of each kind of soil.

5. To observe problems in soil identification, mapping classification, and interpretation, and arrange for data necessary to solve the problems.

An accurate description of each soil mapping unit is one of the products of a soil survey, and is necessary if worth-while use is to be made of the soil map. If the proper data and observations are accumulated in the descriptive legend and field notes, the writing of good descriptions becomes merely a matter of organizing the facts in good literary form.

Sampling of soils: During the course of a soil survey, samples are taken of the horizons in at least one representative profile of each important kind of soil, and each horizon is described in the technical terms given in the Soil Survey Manual. Generally, at least one profile is described and sampled within each soil series. If only one profile of a series is sampled, it generally should be a model profile; that is, a representative one of the kind most commonly encountered in borings and excavations, and one near the central concept of the series. If the soils of a series are extensive, if the range of some characteristics of the series is wide, or if the distinctions from other related soil series need to be more firmly established, samples of one or more non-modal profiles may also be obtained for study and analysis.

H. Classification of Soils.

A classification of objects or of abstract concepts is an arrangement in the mind of ideas about the items classified. The purpose of a classificarion is to arrange ideas so that they accompany or follow one another in a way that gives us command of our knowledge and leads most directly to the acquisition of more knowledge.

Many classifications of soils have been made and many others are possible. Principles of classification as they can be applied to soils have been treated in several important papers. Three papers by Dr. M.G. Cline are particularly recommended for the serious student (3, 4, 5).

A classification of soils can be either natural or technical. Either kind is an arrangement of ideas about individual soils in classes, so that the soils of a class have certain characteristics in common. A natural classification is one based on characteristics of the soils that can be observed or measured, without inferences about genesis of the characteristics and without implications about significance of the characteristics when the soils are managed. A natural classification, to be useful, needs to be comprehensive. It should take in, for example, all the known soils of a continent or, preferably, of the world; and it should be capable of expansion to take in new soils as they are discovered. A technical classification, in contrast, is often designed to have much more limited conceptual scope and geographical range. A listing of soils suitable for growing rice in the coastal plain of Guyana, for example, would be a limited technical classification. The capability grouping of soils is a broader technical classification, but a capability grouping designed for practical use in one country or geographic region seldom can be applied directly in another.

This section deals only with natural classification of soils. Technical groupings, including the capability classifications as it is applied in this country, are treated under Uses of Soil Maps and Reports.

A natural classification of soils, to be useful, must be a multicategoric grouping. The objects classified, which we call individual soils, are first grouped into classes called soil series; and are grouped further into broader classes at successively greater levels of generalization. Each level of grouping is called a category. The classes within each category (that is, the classes at each level in the system) must include all the individuals in the population. This technical meaning of the term category needs to be noted, since the term is often used as synomymous with class.

Two classifications of soils are in widespread use and will be described briefly. One is the classification of soils in orders and great soil groups, which was published by Baldwin, Kellogg and Thorp in Soils and Men, the United States Yearbook of Agriculture for 1938 (1); modified substantially in a paper by Thorp and Smith in Soil Science in 1949 (20); and modified slightly, mostly by suggesting additional great soil groups, by others from time to time. The other classification is the one published by the Soil Survey Staff of the United States in 1960 (18), after nearly a decade of work through successive drafts called approximations. The draft of 1960, designated the Seventh Approximation, was further modified in 1964 (12) and was placed in general use by the United States Soil Survey in 1965. The two classifications reflect somewhat different points of view but both are in widespread use and a modern soil scientist needs to be familiar with both of them.

Some selected examples of past soil classifications were summarized in presenting the Seventh Approximation of 1960 (18) and will be mentioned here to give a slight background for the discussion that follows. A natural classification of soils was impossible until it was recognized that soils are independent natural bodies, each with distinctive morphology. V.V. Dokuchaiev in Russia recognized this principle, and published a classification of soils in 1886 and a revision in 1900. Some of his soil types resemble, in characteristics and in name, some of the great soil groups of the 1938 system. Sibirtsev, a collaborator of Dokuchaiev, introduced the concepts of zonal, intrazonal, and azonal soils, which became the three orders in the classification of 1938. Between 1899 and 1913, Whitney and his co-workers in the United States developed a classification of soils into named series, which were then grouped at a high level into soil provinces and regions. This high level grouping was based largely on geology and physiography, and was mostly a geographical grouping rather than a generalization of soil characteristics. The soil series, much as it was defined by Whitney, remains as the lowest category in the present day system; but a soil series today is defined much more precisely, with respect to range of characteristics in its component soils and the differentiae from competing series, than it was in Whitney's time.

Coffey in the United States in 1912 suggested a classification of soils based on characteristics of the soils themselves, and evidently was familiar with the Russian work. Marbut studied the Russian work thoroughly, and in 1922 published a classification that emphasized soil characteristics and named many of the great soil groups; but his classification was based almost entirely on mature soils as he defined them, and did not accommodate well the intrazonal and the azonal soils.

A comprehensive classification, in orders and great soil groups, was published in the U.S. Yearbook of Agriculture for 1938. This classification was applied throughout the United States and in many other countries, including nearly all the developing countries that received soil survey assistance from the Food and Agriculture Organization of the United Nations or from the foreign aid activities of the United States. Since it has been applied to thousands of soil series in many parts of the world, and will appear in publications for many years to come, it is described briefly here, and the great soil groups most commonly recognized are listed.

The soil classification of 1960, as modified through 1964, is also described briefly. It reflects a radical departure from the old points of view; an intention to include all soils and to leave room for those not yet discovered; and a determined effort to fix limits of each class in each category in terms of soil characteristics that can be measured or observed uniformly by different people. A new nomenclature was devised, to get as far as possible away from prejudices inherent in the use of familiar words with new meanings and unfamiliar definitions,

Soil Order and Great Soil Groups, 1938

In the soil classification system of 1938, four categories above the soil series were defined. Beginning with the most inclusive, these categories are the order, the suborder, the great soil group, and the family. The suborder and the family categories were never fully defined, however, and have been little used. In the United States, attention has been concentrated on the classification of soils into types and series, and grouping of the series in great soil groups and orders. The orders, suborders, and great soil groups are listed here in two parts: Part 1 contains the great soil groups that are represented in Guyana, and Part 2 contains those that occur elsewhere.

The zonal order is made up of soils that have well-developed soil characteristics, and reflect the influence that climate and living organisms, chiefly vegetation, have had on well-drained but not excessively drained soil materials over a long period. Zonal soils are considered to be normal soils. They are in a state of equilibrium, or perhaps more accurately in a steady state, with their environment, and many of their main characteristics are the results of that environment rather than of the parent material. For those reasons soils tend to resemble one another, in many characteristics, over a broad zone where the environment is uniform, even though there are differences in the kinds of soil materials.

In the intrazonal order are soils that have well developed soil characteristics which reflect the dominating influence of some local factor of relief or parent material over the normal effects of climate and vegetation. Many of the wet soils in Guyana, especially the peat soils and the wet clay soils that have developed horizons, are intrazonal soils.

Azonal soils (soils not occurring in zones) lack well developed soil characteristics because of their youth, or because the nature of their parent material or relief prevents the development of a normal zonal soil. Azonal soils include those that consist mainly of alluvial sediments little affected by soil-forming processes; deep sands that contain few weatherable minerals; and shallow or stony soils over either hard or fractured rocks.

Each great soil group contains a large number of soils. The soils of each great group have certain internal features in common, but they can differ significantly in features that affect their use and management. Units of classification below the great group therefore are generally needed for mapping soils and interpreting their performance. In the system that has been applied in the United States, and in many other countries, individual soils are classified in types. Soils of one type, or of two or more types if the only difference is in texture of the surface soil, make up a soil series. Each soil series is given a name taken from some geographic feature. The soil series name and the class of soil texture form the name of a soil type; for example, Mara clay and Kasarama loamy sand are names of soil types.

The following list of great soil groups is in two parts. Part 1 contains the great groups recognized in Guyana. Part 2 contains those recognized elsewhere but not yet in this country.

Part 1. Soil Orders and Great Soil Groups in Guyana

Zonal Soils.

Characteristics of zonal soils reflect dominant influences of climate and organisms rather than nature of the regolith. Most zonal soils are gently sloping to moderately steep and are at least moderately well drained. Soil horizons are evident to prominent.

Light coloured, leached (podzolized) soils:

Soils contain a light coloured A2 horizon and a red, yellowish red, or yellow more clayey B horizon: Red-Yellow Podzolic soils.

Lateritic soils, which contain considerable amounts of the oxides of iron and aluminium:

Soils do not contain a light coloured A2 horizon. The A1 horizon is thick; the A3 horizon is transitional to the B horizon. The B horizon contains accumulated clay. Generally underlain by basic rocks: Reddish-Brown Lateritic soils.

Soil horizons can be distinguished but have mostly gradual boundaries. No clay skins in the B horizon. Strongly weathered and leached. The B horizon can be yellow, brown, or yellowish red: Red-Yellow Latosols, Brown Latosols.

Intrazonal soils:

Characteristics reflect dominance of some local factor of relief or parent material in soil formation. Horizons are evident to prominent.

Hydromorphic (wet) soils:

Organic soils in swamps or marshes: Bog soils.

Mineral soils, A1 horizon very dark grey or black and at least moderately thick (8 inches or more); soil is wet most of the time unless artificially drained: Humic Gley soils.

Mineral soils, A1 horizon is dark grey, or if very dark grey is thin (less than 8 inches); soil is poorly or very poorly drained; that is, wet most of the time unless artificially drained. Low Humic Gley soils.

Mineral soils in which the profile contains one or more horizons that contrast sharply with an adjacent horizon because of high clay content, cementation, or compactness: Planosols.

Soils in which the A2 horizon is nearly white and is strongly leached. The B horizon is prominent, is brown or black, and contains organic matter; the soil is wet much of the year: Ground-Water Podzols.

Soils that contain a layer of concretionary or cemented oxides of iron or aluminium, hardened or becomes hard on drying; or coarse, prominent mottles of such material. Soil is wet at least part of the time: Ground-Water Laterite soils.

Azonal soils:

Horizons are not evident, except for slight darkening of the surface layer.

Recent alluvial sediments, mostly stratified: Alluvial soils.

Deep sands, not recent alluvium: Regosols.

Shallow or extremely stony soils over consolidated rocks that may be either in place or fractured: Lithosols.

Part 2. Great Soil Groups not yet Identified in Guyana

Zonal soils (defined in Part 1.)

Cold zones:

Dark brown surface soil, grey subsoil, frozen substratum: Tundra soils.

Dark brown A horizon, light coloured B and C horizons, cold, subhumid: Subarctic Brown Forest soils.

Light coloured, arid:

Arid, light coloured, contain carbonates: Desert soils.

Arid, lightcoloured, carbonates deeper than in Desert soils: Sicrozems.

Arid, reddish soils, warm climate: Red Desert soils.

Brown A horizon, carbonates at 1 to 3 feet: Brown soils.

Reddish brown A horizon, carbonates at 1 to 3 feet: Reddish Brown soils.

Soils of the forest-grassland transition:

Dark brown to black surface soil, leached, light coloured subsurface layer: Degraded Chernozems.

Brown A horizon, neutral or slightly acid: Noncalcic Brown soils.

Light coloured soils of forested regions:

Light coloured, leached A horizon over a spedic horizon: Podzols.

Soil horizons, especially A2, less distinct than in Podzols: Brown Podzolic soil.

Leached A2 horizon, brown blocky B, medium acid: Grey-Brown Podzolic soils.

More acid, less distinct B than Grey-Brown Podzolic soils: Sols Bruns Acides.

Less acid than Grey-Brown Podzolic soils, may contain carbonates: Grey Wooded soils.

<u>Dark coloured semi-arid to humid:</u>

Dark A horizon, carbonates: <u>Chestnut soils</u>.

Reddish, dark A horizon, carbonates: <u>Reddish chestnut soils.</u>

Black A horizon, carbonates at 1 1/2-4 feet: <u>Chernozems</u>

Black or very dark A horizon, no carbonates in solum: <u>Brunizems</u>

Similar to Brunizems but Reddish: <u>Reddish Prairie soils</u>

Intrazonal soils (defined in Part 1.)

Halomorphic soils:

Salty soils, faint horizons: <u>Solonchak</u>.

Alkaline soils, columnar B horizon: <u>Solonetz</u>.

Some features of Solonetz, but neutral or acid: <u>Soloth</u>

Hydromorphic soils:

Wet soils at high altitude: <u>Alpine Meadow soils</u>.

Calcimorphic soils:

Brown, forested, calcareous substratum: <u>Brown Forest soils</u>.

Dark soil over soft, chalky lime: <u>Rendzinas</u>.

Dark soil, faint horizons, high shrink-swell: <u>Grumusols</u>.

Calcareous, arid or semi-arid: <u>Calcisols</u>.

Dark soils on volcanic ash:

Dark soils on volcanic ash, contain amorphous clay: <u>Ando soils.</u>

<u>The soil classification of 1960</u>

A new soil classification was published in preliminary form by the Soil Survey Staff, United States Department of Agriculture, in 1960. Development of the system had begun in 1951. Before 1960, the outline had been circulated to many hundreds of soil scientists in several countries through a series of drafts called approximations. The publication of 1960, called the Seventh Approximation (18), was presented to participants in the Seventh International Congress of Soil Science at Madison, Wisconsin, U.S.A. in that year, and was circulated more widely than the earlier drafts. Further important changes in the system were made in a memorandum dated June 22, 1964 (12). A publication showing placement of all established soil series of the United States in families and in higher categories of the new system is planned for early release. Suborders, groups, and subgroups of two orders in the new system (Oxisols and Histosols) are still in the process of definition and review in 1966.

Why a new system?

Answers to this question have been published by Charles E. Kellogg (11) Marlin G. Cline (5) Roy W. Simonson (14), and several others. Kellogg pointed out, concerning the soil orders and great soil groups of 1938:

1. Many concepts of great soil groups are based on factors outside the soil, and definitions are ambiguous.

2. Definitions of the three orders are ambiguous.

3. Some soils are classified on properties that are destroyed under culture.

4. Definitions have been attempted in terms of too few properties.

5. Nomenclature of many great soil groups suggests overemphasis on colour.

6. The nomenclature for great groups evolved from several languages, so that with mixtures of nouns and adjectives it is difficult to name intergrades.

Cline pointed out further that the old definitions were vague, whereas in the new system boundaries between classes are drawn on the basis of quantitative values. Moreover, experience for more than 25 years had revealed inadequacies in the old system and had led to definition from time to time of new great soil groups. Great soil groups, although treated as classes in a single category, were found in fact to be of unequal scope and rank. Latosols, in particular, had come to be regarded as having status more like that of a suborder than of a great soil group. Several great groups of Latosols were described and named by Cline in the Soil Survey of Hawaii.

Definitions of diagnostic horizons.

The new classification is based as far as possible on facts about soils that can be seen or measured, and can be described in the same terms by different observers. Terms for describing characteristics of soils are given in the Soil Survey Manual. Each soil horizon of course must be described separately. Designations of major soil horizons, A, B, C, and R, designations of subhorizons, and conventions for indicating briefly certain important properties of horizons were changed as the work proceeded. The new conventions are given in a supplement to the Soil Survey Manual, issued May, 1962, replacing pages 173-188, and are summarized in this Guide in the section, Designations for Soil Horizons and Layers. Designations for six kinds of surface horizons, six kinds of diagnostic subsurface horizons, two kinds of dense subsoil layers called pans, and three kinds of other horizons were also developed or brought together as a basis for the new system. Brief mention of each of these important terms can be made here, but the reader must consult publications on the new system to obtain workable definitions of many of them.

The horizon at the surface of a soil is called the epipedon. This new word is approximately a Greek equivalent for upper soil, and is pronounced to rhyme with head on.

A mollic epipedon (from Latin mollis, soft) has moderate or strong structure, is dark coloured, has more than 50 percent base saturation with calcium as the dominant metallic ion, contains at least 1 percent organic matter, has a thickness of at least 10 inches if the solum is 30 inches, and contains less than 250 parts per million of P_2O_5 soluble in citric acid. The thickness can be as little as 4 inches if the epipedon rests directly on hard rock; if the solum is less than 3 feet thick, its thickness must be one-third of that of the solum.

An anthropic epipedon meets all the requirements for a mollic epipedon except that it has more than 250 parts per million of P_2O_5 soluble in citric acid. It is formed under a long-continued system of farming.

An umbric epipedon cannot be distinguished by the eye from a mollic epipedon when moist, but has base saturation of less than 50 percent, or is both hard and massive when dry.

A histic epipedon (from Greek histos, tissue) is one at or near the surface, saturated with water unless artificially drained, that contains a specified large amount of organic matter, and is less than 12 inches thick (less than 16 inches it is a mineral surface layer over peat or muck).

An ochric epipedon (from Greek ochros, light coloured) is one too light in colour, too low in organic matter, or too thin to be mollic, umbric, anthropic, or histic.

Six kinds of diagnostic subsurface horizons have been described. They form beneath the surface. Some of them can be formed immediately under a layer of leaf litter, and any of them may be at the surface if a soil has been truncated by erosion.

An argillic horizon is an illuvial horizon in which layer-lattice silicate clays have accumulated by illuviation in a significant amount. Evidence of translocated clay is obtained by studying the amount of clay present in both the eluvial and the illuvial horizon, and by inspection for oriented clay particles in bridges between sand grains or in clay skins on faces of peds or in fine pores. Detailed specifications are given and should be studied; at the time this is written they are available in the memorandum of June 1964, and publication is expected.

An agric horizon is an illuvial horizon of clay and humus formed under cultivation; one in which clay and humus have accumulated as thick, dark lamellae, or as coatings on ped surfaces and in wormholes, and occupy at least 15 percent of the horizon by volume.

A natric horizon has the properties of an argillic horizon, but has also:

1. columnar, or less commonly, prismatic structure, and

2. more than 15 percent saturation with exchangeable sodium.

The natric horizon is common to most soils that have been called solonetz or solodized-solonetz.

A spodic horizon is an illuvial horizon in which amorphous materials that have high cation exchange capacity, including organic colloids and iron and aluminium oxides, have accumulated by illuviation in a significant amount. It may form just below an organic horizon, or below an eluvial mineral horizon, usually an albic horizon. A spodic horizon corresponds closely to the B horizon of Podzols, as those soils have been described in North America and in Western Europe.

A cambic horizon (from Latin cambiare, to change) is a changed horizon, not coarser than loamy very fine sand, that has soil structure; contains some weatherable minerals; shows evidence of alteration by formation of grey or blue colours, formation of redder hue or stronger chroma than those in underlying horizons, or removal of carbonates; and is not cemented or indurated.

Categories of the system:

The system consists of classes in six categories; a category, as used here, is a set of classes defined at the same level of abstraction, and including all the soils in its classes. Beginning with the most general, the categories are the order, suborder, great group, subgroup, family, and series.

In the highest category there are ten orders. It is believed that they accommodate all known soils and any others that may be discovered. At the next lower level, 36 suborders have been defined and others may be needed; the range is from 2 to 6 suborders within each order. When the system is reasonably complete, there will be in the magnitude of 120 great groups, 400 subgroups, and 1500 families. The last two figures cover only soils in the United States. In the lowest category, about 7000 soil series have been recognized in the United States; if world-wide soil correlation were to be done at the series level, the number of series might be from 2 to 10 times that number. In practice, because of local pride and difficulties in correlation, the number of series names is likely to be larger than strict soil correlation would require.

Nomenclature

Names for the classes were not assigned until the work on this classification had been in progress for several years. Numbers were used instead of names in the first six approximations. Then, with the help of two scholars in classic languages, a system of coined connotative names was devised. To make use of the system, it is necessary to memorize (or to have at hand for reference) about 70 formative elements that are used to build the words. Most of the formative elements are single syllables. Nearly all were derived from Latin or Greek, but a few came from other sources; a few are non-sense syllables that were selected to fit into the system.

Names are distinctive for the classes in each category, so that each name shows the category in which the class belongs. Names of the ten orders in the highest category consist of three or four syllables. Each ends with the suffix sol, and each contains a key syllable that appears in the names of all suborders, great groups, and subgroups of soils within that order. Suborders are named with words of two syllables the name of each suborder contains the key syllable from the name of the order, plus a descriptive prefix. Most of the great groups have names of three syllables, each formed from the name of the suborder plus a descriptive prefix. Subgroups have names of two or more words, the name of the great group plus one or more modifying adjectives. For example, the order of Entisols contains soils that lack diagnostic horizons (and do not contain evidence that pronounced shrinking and swelling have taken place). The suborder that represents the central concept of Entisols is named Orthents; another suborder consist of Psamments (sandy Entisols). Great groups of Orthents (cold), and Agrorthents (built up by human activity). Subgroups of Haplorthents (the central concept) and Aquic Haplorthents (wet). The system allows for double modifiers, such as Aquic Cumulic Haplorthents; but a subgroup with two modifiers has not yet been named in Guyana.

Names and brief descriptions of orders

Names and partial definitions of the orders are given in this section. The short definitions are useful for a general view of the system, but many details have been omitted that are essential for classification of particular soil individuals. The scientific worker therefore needs to consult the specific publications for precise definitions.

The first 9 orders consist of mineral soils; in some of the soils a histic epipedon may be present. The tenth order, Histosols, contain the soils that are composed dominantly of the remains of plants.

The order of Vertisols consists of soils that contain more than 30 percent clay below a depth of 2 inches, and have more than 30 milliequivalents of cation-exchange capacity per 100 grams of soil; they have at some season, if not irrigated, cracks from about a half an inch to 10 inches wide that reach at least to the middle of the solum; and they have (1) gilgai relief, (2) slickensides close enough to intersect, or (3) wedge-shaped or parallelepiped natural structural aggregates with their long axes tilted 10 to 60 degrees from horizontal. Because of the results of shrinking, cracking, and swelling, they have been called self-mulching or self-swallowing soils. The name was chosen to suggest inversion, or turning. Because of the mixing caused by the shrinking and swelling, the soils are likely not to have distinct horizons. The key syllable for derivation of names of suborders, groups, and subgroups is ert.

Entisols are soils other than Vertisols that have no diagnostic horizon other than an ochric or anthropic epipedon, an albic horizon, or if the N value (a measure of softness) is great enough, a histic epipedon. Thus, they are soils without diagnostic horizons or with only the beginnings of horizons. The key syllable is ent, a syllable not derived from a classic root and without meaning in other usage; that is, a non-sense syllable. The word recent can be an aid for the memory, since many Entisols consist of recent alluvium.

Inceptisols are soils that have no spodic, argillic, oxic, calcic, salic, or gypsic horizon; but contain a cambic horizon, an umbric or a histic epipedon, a fragipan that has no clay skins as thick as 1 millimeter, a duripan, or other evidence of formation of soil horizons. A mollic epipedon is permitted if certain other requirements, specified in the definition, are met. Soils with a plaggen epipedon are classified in this order. The name suggests inception, or beginning, of soil formation. The key syllable for names in lower categories is ept.

Aridisols lack an oxic or a spodic horizon but have an ochric epipedon and contain evidence of formation in a dry climate, such as a calcic, gypsic, cambic, or duripan horizon along with specified conductivity of the satuation extract; or a salic or a natric horizon. The name suggests arid soils and the key syllable, or formative element for derived names in lower categories, is id.

Mollisols have a mollic epipedon and also meet several other requirements; for example, no oxic or spodic horizon. The name is derived from the Latin for soft, and the formative element for derived names is oll. The Chernozems, Brunizems, Chestnut soils, Rendzinas, and some Gley soils are classified as Mollisols.

Spodosols contain a spodic horizon, or a thin horizon cemented by iron that overlies a fragipan and meets all requirements of a spodic horizon except thickness. The formative element for derived names in lower categories is od. The Podzols, Brown Podzolic soils, and Ground-water Podzols are classified as Spodosols.

Alfisols do not have a spodic horizon, an oxic horizon, or a mollic epipedon. Most of them contain an argillic horizon, and have in some horizon a base saturation (by sum of cations) of more than 35 percent. Some have a fragipan. The formative element is alf, a non-sense syllable, but one chosen to suggest accumulated iron and aluminium. Alfisols include Gray-Brown Podzolic soils, Grey Wooded soils, Noncalcic Brown soils, and some soils from other great groups in the older classification.

Ultisols do not have an oxic or a spodic horizon, and do not contain within 50 inches soft plinthite (clay that hardens irreversibly on repeated drying) that forms a continuous phase that constitutes more than half the matrix. They have an argillic horizon, or a fragipan that has clay skins more than 1 millimeter thick, and they also meet other requirements, The formative element is ult. Red-Yellow Podzolic soils, and Reddish-brown Lateritic soils of the U.S. are classified as Ultisols.

Oxisols contain an oxic horizon, or have plinthite within 2 meters of the surface. The formative element for names in lower categories is ox. Soils classified as Latosols and as Ground-Water Laterite soils are in the order of Oxisols.

Histosols are the soils composed chiefly of organic remains. They have been called Bog soils; the order includes also some Half-Bog soils. The formative element for derived names is ist.

Formative elements in names of suborders

Suborders have names of two syllables. Each consists of a descriptive prefix joined to the formative element from the name of the order. The 22 descriptive prefixes, their derivation, and a brief definition of each, are given in the following list.

Formative element	Derivation	Connotation
Acr	Gk akros, highest	Most strongly weathered
Alb	L. albus, white	Presence of an albic horizon
And	Jap. ando, dark	Contains ash or amorphous clay
Aqu	L. aqua, water	Wet soil
Ar	L. arare, to plow	Disturbed soil
Arg	L. argilla, white (clay)	Contains an argillic horizon
Bor	L. boreas, north	Cold soil
Ferr	L. ferrum, iron	Presence of iron
Fibr	L. fibra, thread	Fibrous
Hum	L. Humus, earth	Presence of organic matter
Len	-	Partly decomposed
Ochr	Gk, ochros, pale	Presence of ochric epipedon
Orth	Gk. orthos, true	Common (Central concept)
Pagg	Ger. plaggers, meadow	Presence of a plaggen epipedon
Psamm	Gk. psammos, sand	Sand texture
Rend	Rendzina	Rendzina-like
Sapr	Gk. sapros	Well decomposed
Trop	Eng. tropics	Dark soil, no extremes of temperature
Ud	L. udus, humid	humid climate
Umbr.	L. umbra, shade	Presence of umbric epipedon
Ust	L. ustus, burnt	Dry climate, hot summer
Xer	Gk. xeros, dry	Dry soil more than 60 consecutive days in most years

Formative elements in names of great groups

Most great groups have names of three syllables, formed by placing a descriptive prefix before the name of the suborder. A few of the descriptive prefixes contain two syllables, giving names of four syllables. Each formative prefix is restricted to a single category in any one order; for example, one suborder within Mollisols is Albolls; the prefix alb then does not appear in the name of any great group in that order. Within the Alfisols, however, the prefix alb is not used at the level of suborders, and is available for the great group of Albaqualfs. In the order of Spodosols, the prefix ferr is needed to name a suborder of Ferrods, and a prefix derived from the Greek word for iron is therefore used to name a great group of Sideraquods within the suborder of Aquods.

Formative elements for names of great groups are given in the following list.

Formative element	Derivation	Connotation
Acro	Gk. akros, highest	Most highly weathered
Agr	L. ager, field	Contains an aquic horizon
Alb	L. albus, white	Contains an albic horizon
And	Jap. ando, dark	Contains ash or amorphous clay
Anthr	Gk. anthropos, man	Contains an anthropic horizon
Aqu	L. aqua, water	Wet soil
Arg	L. argilla, white (clay)	Contains an argillic horizon
Calc	From calcium	Contains a calcic horizon
Camb	L. cambiare, to exchange	Contains a cambic horizon
Cry	Gk. kryos, coldness	Cold
Dur	L. kurus, hard	Contains a duripan
Dystr	From dystrophic, infertile	Low base saturation
Eutr	From eutrophic, fertile	High base saturation
Ferr	L. ferrum, iron	Contains iron
Fragi	L. fragilis, brittle	Contains fragipan
Gloss	Gk. glossa, tongue	Tongued
Grum	L. grumus, crumb	Granular structure
Hal	Gk. hals, salt	salty
Hapl	Gk. haplous, simple	Minimum horizon
Hum	L. humus, earth	Contains humus
Hydr	Gk. hydor, water	Contains water
Maz	Gk. maza, flat cake	Massive
Moll	L. mollis, soft	Soft horizon
Nadur	Na, sodium, + dur	Natric horizon and duripan
Natr	L. natrium, sodium	Contains a natric horizon
Ochr	Gk. ochros, pale	Presence of an ochric epipedon
Norm	Normal	Central concept at the great group level
Plac	Gk. plax, flat stone	Contains a pan
Plinth	Gk. plinthos, brick	Contains plinthite
Quartz	Quartz	High quartz content
Rhod	Gk. rhodon, rose	dark red colour
Sal	L. sal, salt	Contains a salic horizon
Sider	Gk. sideros, iron	Contains iron
Therm	Gk. thermos, hot	warm
Umbr	L. umbra, shade	contains umbric epipedon
Ust	L. ustus, burnt	dry climate, usually hot summer
Verm	L. vermer, worm	mixed by worms or other animals
Vet	L. vetus, old	weathered

List of orders, suborders and great groups:

Names in the system as of late 1964 are reproduced here to illustrate how the names were derived and to provide a framework for the classification that follows, in subgroups and families, of the soil series in British Guiana. As already stated, the classification was still in process of development at the end of 1964. Numbers in parenthesis were used instead of names in earlier approximations of the system. Absence of names indicates that the system is not yet complete.

Order	Suborder	Great group
Entisols (1)	Arents (1.6)	
	Orthents (1.5)	Agrorthents (1.52)
		Cryorthents (1.51)
		Haplorthens (1.53)
	Psamments	Aquipsamments (1.X1)
		Cryopsamments (1.X4)
		Normipsamments (1.X3)
		Quartzipsamments (1.X2)
Vertisols (2)	Aquerts (2.1)	Grumaquerts (2.11)
		Mazaquerts (2.12)
	Usterts (2.2)	Grumusterts (2.21)
		Mazusterts (2.22)
Inceptisols (3)	Andepts (3.2)	Cryandepts (3.21)
		Durandepts (3.22)
		Hydrandepts (3.25)
		Mollandepts (3.26)
		Normandepts (3.24)
		Vitrandepts (3.23)
	Aquepts (3.1)	Andaquepts (3.16)
		Cryaquepts (3.14)
		Fragiaquepts (3.13)
		Halaquepts (3.11)
		Humaquepts (3.12)
		Normaquepts (3.15)
	Ochrepts (3.4)	Cryochrepts (3.41)
		Dystrochrepts (3.44)
		Eutrochrepts (3.43)
		Fragiochrepts (3.46)
		Ustochrepts (3.45)
	Plaggepts (3.6)	
	Tropepts (3.5) (tentative)	
	Umbrepts (3.3)	Anthrumbrepts (3.34)
		Cryumbrepts (3.31)
		Fragiumbrepts (3.35)
		Haplumbrepts (3.33)
Aridisols (4)	Argids (4.2)	Durargids (4.22)
		Haplargids (4.21)
		Nadurargids (4.24)
		Natrargids (4.23)
		Normargids (4.25)
	Orthids (4.1)	Calciorthids (4.13)
		Camborthids (4.11)
		Durorthids (4.12)
		Salorthids (4.14)

Order	Suborder	Great group
Mollisols (5)	Albolls (5.2)	Argialbolls (5.21) Natralbolls (5.22)
	Aquolls (5.3)	Argiaquolls (5.32) Calciaquolls (5.33) Cryaquolls (5.36) Duraquolls (5.34) Haplaquolls (5.31)
	Borolls (5.4)	Argiborolls (5.43) Haploborolls (5.42) Natriborolls (5.45) Vermiborolls (5.41)
	Rendolls (5.1)	
	Udolls (5.5)	Argiudolls (5.53) Hapludolls (5.52) Vermudolls (5.51)
	Ustolls (5.6)	Argiustolls (5.63) Calciustolls (5.65) Durustolls (5.64) Haplustolls (5.62) Natrustolls (5.66) Vermustolls (5.61)
	Xerolss (5.7)	Argixerolls (5.72) Durixerolls (5.73) Haploxerolls (5.71)
Spodosols (6)	Aquods (6.1)	Cryaquods (6.11) Duraquods (6.16) Fragiaquods (6.17)) Normaquods (6.12) Placaquods (6.14) Sideraquods (6.13) Thermaquods (6.15)
	Ferrods (6.4)	
	Humods (6.2)	Fragihumods Normihumods
	Orthods (6.3)	Cryorthods (6.31) Fragiorthods (6.34) Normorthods (6.33) Placorthods (6.32)
Alfisols (7)	Aqualfs (7.1)	Albaqualfs (7.11) Fragiaqualfs (7.15) Glossaqualfs (7.12) Natraqualfs (7.16) Ochraqualfs (7.13) Umbraqullfs (7.14)

Order	Suborder	Great group
	Boralfs (7.2)	Cryoboralfs (7.21) Eutroboralfs (7.22) Fragiboralfs (7.24) Glossoboralfs (7.25) Natriboralfs (7.23)
	Udalfs (7.3)	Agrudalfs (7.31) Ferrudalfs (7.37) Fragiudalfs (7.33) Natrudalfs (7.36) Normudalfs (7.32)
	Ustalfs (7.4)	Durustalfs (7.41) Haplustalfs (7.46) Natrustalfs (7.42) Normustalfs (7.45) Rhodustalfs (7.43) Vetustalfs (7.44)
Ultisols (8)	Aquults (8.1)	Fragiaquults (8.14) Ochraquults (8.12) Plinthaquults (8.11) Umbraquults (8.13)
	Humults (8.5)	Ochrihumults (8.52) Umbrihumults (8.51)
	Udults (8.2)	Fragiudults (8.24) Normudults (8.23) Plinthudults (8.21) Rhodudults (8.22)
	Ustults (8.4)	Fragiustults (8.42) Normustults (8.41)
Oxisols (9)	Aquox (9.1)	Plinthaquox (9.11) Normaquox (9.12)
	Humox (9.2)	Acrohumox (9.21) Haplohumox (9.22) Vermihumox (9.23)
	Ustox (9.3)	Mollustox (9.31) Haplustox (9.32)
	Xerox (9.4)	Normixerox (9.41)
	Orthox	Umbriorthox (9.51) Udorthox (9.52) Haplorthox (9.53) Anthrorthox (9.54)

Histosols (10) Classification in progress, 1964.

Classification of soils in Guyana

Classification in the new system of each of the soils named and mapped in Guyana since about 1957 is given in the following list. Numerical symbols given along with the soil series names were used in the semi-detailed soil surveys made under the British Guiana-United Nations Special Fund Project of 1961-64, or in soil surveys made by the Soil Surveys Section of the Division of Chemistry and Soils.

Soil series names not followed by a number are those established by soil surveyors of the Regional Research Centre, Trinidad, and published in the soil survey reports dated 1958 and 1959.

Placement, in the new classification, of soil series mapped in the project of 1961-64 was made by soil scientists of that project, under leadership of Glenn H. Robinson, Senior Soil Surveyor. The placings were revised in 1965 and 1966 by J.G. Steele, to conform with important changes in nomenclature that were circulated by the United States Soil Survey in June, 1964. Classification of soil series described in published soil surveys of the Regional Research Centre, dated 1958 and 1959, was made in 1965 by J.G. Steele. Many of those published descriptions do not contain the data needed for classification in this system, and other soil scientists might not agree with the classifications based on the data at hand; the placements should be regarded, therefore, as a working draft, subject to changes if new data are obtained or if the interpretations made of existing data are found to be faulty.

The list contains names of subgroups and families in the new classification. The name of each subgroup, as already explained, indicates also the name of the order, suborder, and great group. Names of families follow the principles set out in a lengthy memorandum of the United States Soil Survey dated June 22, 1964 (12). The placement in a great soil group of the soil classification of 1938 is given; also, for the soils named during and since the 1961-64 project, the land-capability class and subclass are given. It is ordinarily expected that soils in one family will be grouped in the same capability subclass, except for differences in phase criteria such as slope or salt content. The placement in great soil groups has been added for convenience of the large number of soil scientists and others who are acquainted with that system of classification.

Classification of the soils of Guyana

Subgroup and family	Soil series	Capability class and subclass	Great soil group
Aquic Haplorthents			
Clayey, acid	Rupununi de Velde 1	If	Alluvial Low Humic Gley
Clayey, acid over neutral	Black Bush 3	If	Low Humic Gley
	Plegt Anker 5	If	Low Humic Gley
Clayey, non-acid, soft or moderately firm	Corentyne 11	Im	Low Humic Gley
	Skeldon 13	Im	Low Humic Gley
	Whittaker 37	Is	Low Humic Gley
Clayey, acid, soft or moderately firm	Haswell 25	IIs	Low Humic Gley
	Weldaad 44	IIs	Humic Gley
	Fairfield 147	IIs	Low Humic Gley
	Manarabisi 211	IIf	Low Humic Gley
Clayey, acid, soft, sulphate-containing	Mara 21	IIIt	Low Humic Gley
	Macouba 30	IIIt	Low Humic Gley
	Marinero 101	IIIt	Low Humic Gley
Fine silty or clayey, non-acid	Tain 9	IIs	Low Humic Gley
	Whim 75	IIs	Low Humic Gley
Fine silty or clayey, moderately deep over soft, sulphate-containing clay	Tuschen 39	IIf	Low Humic Gley
	Brickery 36	IIf	Low Humic Gley
	Inki 100 (over peat)	IIf	Low Humic Gley
Fine silty, acid	Moleson 8	If	Alluvial
Sandy over clay	Karanambo	-	Low Humic Gley
Typic Haplorthents			
Coarse loamy	Emprensa	-	Regosols-Red Yellow Podzolic soils
Typic Aquipsamments			
Acid	Henrietta 730	IVw	Low Humic Gley
Umbric Aquipsamments			
Acid	Siparuta 732	IVw	Humic Gley
Ultic Aquipsamments			
Non-acid	Waruma	-	Low Humic Gley

Classification of the soils of Guyana (continued)

Subgroup and family	Soil series	Capability class and subclass	Great soil group
Typic Quartzipsamments			
Acid	Tiwiwid 700	IVf	Regosol
	Kwainatta	-	Regosol
	Jacaré	-	Regosol
Umbric Quartzipsamments			
Acid	Tarakuli 702	IIIf	Regosol
Ultic Quartzipsamments			
Acid	Tabela 800	IIIf	Regosol
Aquic Quartzipsamments			
Acid	Novar 70	If	Regosol
Acid over neutral	Ithaca 72	If	Regosol
Typic Thermaquods			
Sandy	Ituni 701	IVw	Ground-Water Podzol
Typic Ochraqualfs			
Clayey	Onverwagt 41	Im	Low Humic Gley
	Buxton 45	Im	Low Humic Gley
	Burru	-	Low Humic Gley
	Long Man Swamp	-	Low Humic Gley
Umbric Ochraqualfs			
Clayey	Lichfield 42	IIs	Humic Gley
	Rosignol 43	Im	Humic Gley
Typic Ochraqualfs			
Clayey, moderately permeable	Everton 31a	If	Low Humic Gley
	Bath 34a	If	Low Humic Gley-Red Yellow Podzolic
Clayey, slowly permeable	Canje 31	IIm	Low Humic Gley
	Vryberg 34	IIm	Low Humic Gley-Red Yellow Podzolic
Oxic Ochraquults			
Fine loamy	Mibirikuru 740	IIIw	Low Humic Gley
	Arima 750	IIIw	Low Humic Gley
	Ambrose	-	Low Humic Gley-Red Yellow Podzolic
Fine silty	Cola 152	IIf	Low Humic Gley
	Putkin 156	IIf	Low Humic Gley
	Potoco 157	IIf	Low Humic Gley-Ground-Water Laterite
Arenic Ochraquults			
Sandy over clay	Makushi	-	Low Humic Gley

Classification of the soils of Guyana (continued)

Subgroup and family	Soil series	Capability class and subclass	Great soil group
Typic Umbraquults			
Clayey, slowly permeable	Kerkenama 32	IIm	Humic Gley
	Dead Man Swamp	-	Humic Gley
Clayey, moderately permeable	Brandwagt 32a	If	Low Humic Gley
Fine loamy	Wiruni 742	IIIw	Humic Gley
	Aroaima 752	IIIw	Humic Gley
Oxic Umbraquults			
Clayey	Vigilante 54	IIw	Low Humic Gley
Ochric Plinthaquults			
Fine silty, moderately permeable	Torani 153	IIf	Ground-Water Laterite
	Helvetia 52, 652	IIf	Low Humic Gley-Ground-water Laterite
	Nassau 57	IIf	Low Humic Gley-Ground-Water Laterite
Coarse Loamy over clay	Cachoeira	-	Ground-Water Laterite
Fine silty, slowly permeable	Huntley 253	IIIm	Ground-Water Laterite
Umbric Plinthaquults			
Clayey	Benoni	-	Ground-Water Laterite
Oxic Normudults			
Deep, clayey	Arakaka 360	IIIe (2)	Red-Yellow Podzolic
	Durban	-	Red-Yellow Podzolic
	Ebini 820	IIf (1)	Red-Yellow Podzolic
	Ikuribisi	-	Red-Yellow Podzolic
	Ireng	-	Red-Yellow Podzolic
	Marabunta Creek	-	Red-Yellow Podzolic
	Sawariwau	-	Red-Yellow Podzolic
	Wauna 350	IIIe (2)	Red-Yellow Podzolic
Plinthic Normudults			
Fine silty	Dageraad 58	IIf	Red-Yellow Podzolic-Ground-Water Laterite
	Yesi 158	IIf	Red-Yellow Podzolic
Coarse loamy	Tirke	-	Red-Yellow Podzolic-Ground-Water Laterite
Oxic Rhodudults			
Clayey	Hosororo 340	IIIe	Reddish Brown Lateritic
	Wichabai	-	Reddish Brown Lateritic

Classification of the soils of Guyana (continued)

Subgroup and family	Soil series	Capability class and subclass	Great soil group
Aquic Fragiudults			
Fine silty	Kamani 53	IIIw	Planosol with fragipan
Typic Udorthox			
Sandy skeletal	St. Ignatius	-	Red-Yellow Latosol
	Tiger Creek	-	Regosol-Brown Latosol
Deep, clayey	Kuma	-	Red-Yellow Latosol
	Kaput	-	Red-Yellow Latosol
	Lethem	-	Red-Yellow Latosol
	Mountain Point	-	Red-Yellow Latosol
Loamy Skeletal	Kamarang (tentative)	-	Brown Latosol
Psammentic Udorthox			
Sandy, siliceous	Kasarama 810	IIf (1)	Red-Yellow Latosol
Psammentic Umbriorthox			
Sandy, siliceous	Wikki 712	IIf (1)	Rubrozem
Histosols, not further classified	Anira 20	IIIm	Bog
	Lama 60	IIIm	Bog
	Baiabo 220	IIIm	Bog

Note 1: A slopes only

Note 2: A, B, and C slopes only

I. Correlation of soils.

Soil correlation is the scientific method by which the set (or combination) of all the significant characteristics of each soil is specifically compared with the sets of characteristics of the kinds of soil already defined and named in the natural or taxonomic system of soil classification; thereby the soil gets its name and its place in the system. (9)

Procedures in soil correlation have been mentioned in connection with the mapping legend, field reviews of soil surveys, and the accurate description of each soil mapping unit. As the final step in correlation of a specific soil survey, the Soil Surveyor in charge approves formally the list of map units to be shown on the prepared soil map of the area, the name by which each is identified, and the description of each. If he finds that changes or additions are needed in the file of approved descriptions of soil series, he provides for the changes to be made; the new or revised descriptions are placed in the soil correlation file and are also circulated to the Officers who are concerned or who have made a request to receive such information.

Steps in soil correlation, including final field review of the soil survey, are the following:

1. Final field review: The Soil Surveyor, or an officer designated by him, reviews the field notes. He examines representative mapping units, (unless he has done that on earlier field reviews) and determines to his satisfaction that the soils have been consistently mapped and adequately described. He reviews the list of soils sampled, and asks for additional samples if he believes any are needed to permit proper characterization and classification of the soils.

2. Study of soil maps, descriptions, and data: The Soil Surveyor and staff study the soil maps, descriptions, and analytical data from the soil survey in relation to the approved descriptions of soil series, the reports of other soil surveys in this country, and soil maps, reports, descriptions, and data from other countries.

3. Field trips by the Soil Surveyor and his staff may be required at this stage, to study soil characteristics over a wider area than that covered by the soil survey now being correlated, in order to arrive at the best possible correlation.

4. After study of the available evidence, the Soil Surveyor prepares, signs, and places in the file a soil correlation memorandum that lists each field mapping symbol, the field name if one was given to the mapping unit during the field soil survey, and the approved name by which the soils of that mapping unit are to be designated on the soil map and in the soil survey report.

5. The Soils Surveyor then prepares, or supervises preparation of, the text of the soil survey report; and supervises preparation of the soil map. The soil map and the accompanying descriptions of the soils, interpretations of the soils, and related information, make up the soil survey report.

Although the soil correlation procedure in a small country need not be either lengthy or complicated, it is essential that it be definite. A specific record of the soils mapped, the name assigned to each kind, and the reasons for the decisions, should be placed in the files for future use.

Information from outside the country should be continually used in describing and correlating soils. Exchanges of publications and of correspondence should be routine. Visits to other countries by the Soil Surveyor, and provision for visits by foreign specialists in soil classification and interpretation should be frequent. The knowledge thus obtained, by reading, conversation, and joint field studies with foreign experts, can return great value for the money spent.

Descriptions of established soil series need to be kept up to date. Many of the soil series named between 1956 and 1966, and especially those named in the publications of 1958 and 1959 have not been characterized fully, or distinguished adequately from other series. New descriptions of one or more soil series may be needed whenever (1) field descriptions of laboratory data are made available; or (2) the Soil Surveyor decides that the conceptual limits of an established series need to be made either more broad or more narrow. Whenever the Soil Surveyor decides to add a new series or to change the recorded range of characteristics of an established series, he prepares descriptions of the new series and of others affected by the decision. He then places the new description in the soil correlation file, and also distributes it to the Soil Survey Staff and to others who have asked to be kept informed of developments in soil classification.

V USES OF SOIL MAPS AND REPORTS

A. Soil Interpretations are Predictions.

We make soil surveys for a practical purpose, to learn the location and extent of different kinds of soil, and the responses that we can expect when we use or manage the soils.

The soils that we classify and map are 3-dimensional individual pieces of landscapes. A soil has depth, area, and shape. Each soil has a combination of characteristics that reflect its whole history. Each soil has evolved in and probably along with its environment, and it interacts in many ways with its present environment. We study soils and classify them into different kinds. A kind of soil has a predictable response to management and to manipulation.

When we use a soil to grow crops, or for any other purpose, we can use it as it is or we can change it. Almost everywhere, we must do something to change the soil. For a crop, we must stir the surface layer enough to prepare a seedbed; usually we must dispose of the trees or other plants already growing; we must press the soil close to the seed or the growing plant; often we must supply part, and sometimes nearly all of the plant nutrients by putting on fertilizer; especially if we want to grow crops for more than one or two seasons. On many soils we need to remove excess water by drainage, bring water to the crop by irrigation, or control the speed of runoff water so the soil does not wash away.

The farm operator judges the cost and practicability of these soil-managing inputs, along with the inputs required to grow, protect, and handle the crop itself, and compares the cost of production with value of the crop. To make useful comparisons he needs soil survey interpretations in the form of predictions of the yields and quality of crops that can be obtained, on each kind of soil, under defined, workable combinations of inputs that are called systems of management.

The precise data needed for good soil survey interpretations in Guyana will not be available for a long time. We can make many useful predictions about performance of the different kinds of soil, but they must be stated in terms more general than many users of the soils would like. Some interpretations can be inferred from characteristics of the soils, and others can be generalized from the experience of farmers and the results of experimental work. Coulter has pointed out (7) that, in the tropics, progress in soil mapping is already far ahead of the progress in gathering knowledge of soil fertility. Knowledge of many other aspects of soil management, such as moisture conservation and control of soil temperature, is even less advanced than our knowledge of soil fertility. Constant effort will be needed for many years to find responses to soils and to devise practical and efficient methods to grow crops while maintaining or improving the soils. In the meantime, the knowledge that we already have is enough to make the difference between success or failure of many projects, and should be put to work by the people who are concerned in any way with land management.

B. Keep Soil Surveys Available.

Soil surveys, if they are to be used, must be available to potential users. The best way to keep soil maps and reports available is to publish them. Soil surveys in many countries are published and are distributed free or sold at a nominal price to farmers and other users. Copies are also deposited in key libraries, including several in foreign countries. In this way preservation of the work for future reference is assured; after the copies for distribution have been exhausted, any user can still obtain parts of the soil map and report at a cost no greater than that of having copies made of the map sheets and pages that are desired.

Publication, however, is expensive and time consuming. Even the large and the developed countries have found that innovations or alternative methods must be found to reduce the cost and reduce the time required to make results of soil surveys available to any users who desire the information.

In Guyana, three soil survey bulletins were published in 1958 and 1959 by the Regional Research Centre for the British Caribbean. Seven volumes will be published soon (this is written in 1966) to cover the soil surveys made by the FAO for the British-Guiana-United Nations Special Fund Project in 1961-64. Successful methods have also been devised, and are in operation, to prepare and preserve a systematic record of current soil surveys. Officials of the Ministry and technical officers responsible for soil surveys will need to see that the practice is continued, and that several file copies of each of these valuable documents are preserved and are kept in the proper depositories.

Each soil map is drafted, at a suitable scale, on tracing paper in sheets of convenient size. Each map contains a soil legend that identifies, by names, and symbols, the soil mapping units. Prints of the maps are made to accompany copies of the soil survey report. The soil survey report is written, stencils are made, and at least 25 copies are reproduced. Additional copies are made if there is demand for them and a good reason why they should be supplied by Government. Copies are distributed to the agencies and officers concerned; in particular, to the Ministry or Office that requested the soil survey and to the director of Agricultural Extension, the Agricultural Officer of the district, and the Agricultural Assistant responsible for extension or other agricultural work in the area surveyed. Moreover, and this is important, copies are filed in libraries of the Ministry of Agriculture and of the Geological Survey. Each library should be asked to hold one copy that is not available for circulation but is preserved for reference. In that way the scientific record is preserved permanently, and anyone in the future can consult a copy or obtain one for himself at the cost of photographic or other reproduction. Original drawings of the soil maps are filed in the Soils Survey Office, and prints can be made when needed. Typed stencils are also preserved as long as they remain in usable condition. Thus, in one or another of three official files, the recora or soil surveys is preserved.

The functioning of this system needs to be reviewed from time to time. The Soil Surveyor should be directed to ascertain, at least once each year, that copies of soil surveys (complete with maps) are still available. The check of maps is especially important since maps can easily be removed from the folders, and a soil survey report without the map has only limited value. This periodic review is of utmost importance whenever changes occur in the soil survey staff or in organization or policy of the participating libraries.

The number of participating libraries should be increased whenever an opportunity arises.

Copies of a new soil survey report should be placed in several public or semi-public places where they will be preserved and where potential users can consult them. Such depositories might be one or more schools in the area surveyed; perhaps also a cooperative society or other organization that deals with agricultural production. Copies should not be given or sent, however, unless there is some assurance they will be preserved and made available to people who want information about the soils.

C. Characteristics and Qualities.

A growing plant needs support, nutrients, water, air, and light. Support, nutrients and water must be furnished by the soil. Most crop plants (rice is an exception) need to have soil air in contact with their roots, and will not grow if water fills the soil pores and shuts out the air for more than one or two days.

An ideal arable soil for most crops has a deep rooting zone, easily penetrated by air, water, and roots. It holds water between rains but allows the excess to pass through and drain away freely. It has a balanced supply of nutrients. It can be kept from washing away during rains and from blowing away during high winds. Rice has special water requirements, and the ideal soil for that crop is level or can be made so, contains a balanced supply of nutrients, can be flooded while the crop is growing, and does not allow excess water to pass through too readily.

Most soils in their natural state fall short of the ideals that have just been described. Characteristics of almost every soil limit its use in some degree. Some of the limitations can be modified; for example, nutrients can be added in fertilizer, soil structure can be improved by adding organic matter, and many fields can be drained or irrigated. Other limitations cannot be changed but must be tolerated and the system of farming must be adjusted to them; for example, a sloping field yields runoff water that has erosive velocity, a sandy soil is likely to be droughty, and many clay soils drain slowly and are sticky when wet. Successful culture of crops or other plants requires management (inputs) to overcome limitations of the soil, along with the management required to grow and protect the plants.

Performance of a soil needs to be stated in reference to a defined level of management. With a high enough level of inputs, almost any use can be made of any soil. A botanic garden in Canada, for example, can change the environment of a soil by building a glass house, and can grow bananas, but of course cannot produce the fruit at reasonable cost. This extreme example helps emphasize the point that every statement about yield or other performance of a soil has back of it several economic assumptions, whether they are stated or not. We need to examine our assumptions from time to time, and re-interpret performance of the soils whenever new varieties of crops or new combinations of crop-producing technology make the old assumptions and interpretations out of date.

The unit of soil interpretation is a kind of soil; that is, a taxonomic unit. The most specific statements about performance of soils can be made about phases of soil types. (Some types are uniform enough, even in the cultural environment, that we do not need to divide them into phases). Interpretations by phases of soil types can be made with precision if we have enough experience and data. In an area with many soil types and phases, however, the interpretations in that form are extremely detailed; for some purposes, we need to generalize them.

To simplify some kinds of interpretations, we make practical groupings of kinds of soil. The purpose of the grouping needs to be defined with care. A general grouping, useful in general planning of agricultural production but not detailed enough for many interpretations, is the one into land-capability classes and subclasses. For some purposes a more limited and specialized grouping is more suitable, such as the grouping into four classes of suitability for a particular crop. We must remember that in every grouping we are combining things that were first set apart because of individual differences, and in the combination some precision is lost.

The unit of soil management is a field or a farm; or for some operators, a larger unit such as a drainage basin or a large ranch. Any practical unit of soil management is likely to have in it soils of different kinds. The land operator needs to know the distribution of soils of different kinds, and the characteristics and expected performance of each. Then, if a single field or operating unit contains contrasting soils, he may be able to vary the treatement of some of them, and at least can be prepared for different responses if he decides on uniform cropping and treatment.

Soil characteristics and qualities affect the responses when plants are grown. Soil characteristics are the items that can be seen or measured, such as the depth of soil, grain size, amount of organic matter, reaction, content of plant nutrients, soil structure, and water-holding capacity. Soil qualities are the results of interactions between soil characteristics and practices, or between characteristics and the environment. Examples are soil fertility, soil productivity, and, for practical purposes, the class of natural soil drainage. Qualities cannot be measured directly but must be inferred from the characteristics that can be observed or measured.

Interactions among soil characteristics, soil qualities, the environment, and applied practices produce crop responses that we want, such as a high yield of good quality; or those that we do not want, such as a crop failure because of drought or of damage by insects. Every soil has a large number of separate but related characteristics; the environment has many characteristics and some of them (such as rainfall) vary from season to season; and the number of combinations of management practices is extremely large. Out of such virtually unlimited possibilities of interaction, useful soil interpretations are made by: 1) observing yields of crops on specific soils under defined workable levels of management; 2) studying the results in relation to the observed and measured soil characteristics and inferred soil qualities and 3) extending the results to predict performance of other similar or contrasting soils.

The major soil characteristics and qualities that affect uses of soils are discussed briefly. Before any soil can be rated or judged, its characteristics and qualities must be studied in relation to each other and to the requirements of the system of farming.

Soil texture is a classification based on grain size; that is, on the proportions of sand, silt, and clay revealed by mechanical analysis. Classes of soil texture are named, according to their mechanical composition, as sands, various loams, and clays. Texture of the surface soil along with other factors influences its structure when cultivated, which is the quality called soil tilth. A clay soil or a loamy soil in good tilth is granular, can be worked easily, and does not form clods on drying. Many clay soils in Guyana, however, are likely to be cloddy and difficult to work. A sand that contains little or no clay does not form granules and is easy to work, but is easily washed by water and if it dries is easily blown by wind.

Amount of organic matter in the surface soil is indicated by colour. A dark colour indicates a moderate or high content of organic matter, unless the soil contains an unusual amount of dark coloured minerals. A moderate content of organic matter (more than about 1 percent) generally goes with good soil tilth in a temperate climate. The relationship is less direct in the tropics.

Soil structure is the arrangement of primary soil particles into aggregates. The aggregates are generally called granules or crumbs if they have been shaped by cultivation, and peds if they are the result of soil-forming processes. Natural soil structure (or the lack of it), meaning the size, shape, strength, and arrangement of peds, is an important characteristic of every soil horizon beneath the cultivated surface soil. An experienced soil scientist can judge permeability of a subsoil by study of its texture and structure, its porosity, and the distribution of roots.

Depth of useful soil is a measure of the zone available for roots of crops and other plants. Some kinds of soil horizons can limit the penetration of roots; for example, a cemented organic-iron pan in some wet soils, a dense fragipan, or in some soils a layer of dense clay that contrasts sharply with the horizons above it. In the mountains and plateaus of this country, depth of many soils is limited by a layer of gravel or by ironstone, sandstone, or other hard rock.

Several soil characteristics affect the ability of a soil to hold water that roots of plants can obtain. The water table, for most crops, must be beneath the root zone, either naturally or held there by artificial drainage. The water supply, through rainfall or irrigation, (or rarely from underground seepage) must be enough to meet the needs of the crops. The available water capacity of the root zone can be measured, at least approximately, by measuring for each significant horizon the water held between one-third atmosphere and 15 atmospheres of tension. These moisture tensions are approximately those of the field capacity and the wilting coefficient. The infiltration rate (rate of intake) needs to be known in order to design an irrigation system, especially a sprinkler system; and to make estimates of expected runoff from rains of usual and unusual intensity and duration.

The quality of soil fertility depends on several soil characteristics that must be considered in relation to one another. Soil reaction, expressed as a pH value, reflects the balance between exchangeable acid and exchangeables bases. To estimate the amount of lime needed, the quantity factor must also be known, preferably by measuring the base exchange capacity and bases. Available supplies of the common nutrients, which are nitrogen, phosphorus, potassium, calcium, and magnesium, can be found by analysis of soil samples. Several other nutrients that are needed only in small quantities, often called minor elements or trace elements, are deficient in many soils of Guyana. The need for them can be detected by analysis of the soils, or some times by observing the crops. Toxic salts, or soluble aluminium, or both, are present in some of the wet soils of the coastal plain. Any salts are toxic if present in large enough amounts. Sulphides of iron, which are especially toxic, are present in some of the soft marine clays that contain organic matter (cat clay). If those soils are aerated, the iron sulphides are oxidized to sulphuric acid or to sulphates, and an extremely acid, toxic soil is formed. Soluble aluminium is present in some of the sulphide-containing soils and in some of the peat soils. Soils that contain sulphides in the subsoil or the substratum can be used for some crops if the water table is regulated carefully, deep enough to keep toxic compounds out of the root zone but not so deep as to permit aeration that forms an extremely acid soil.

Some soil characteristics must be observed beyond the boundary of a single boring or excavation. Slope of the soil surface determines the speed of runoff water and the need for control of runoff and erosion. Position on the slope or in the landscape sometimes must be considered; an upper slope is likely to be droughty; and an enclosed depression might be flooded in wet weather.

Stones or rock outcrops can limit severely the use of an otherwise good soil.

Nature of the substratum is of minor importance in production of most crops, provided there is a sufficient depth of useful soil, but must be considered in many kinds of engineering work. Climate involves rainfall, temperature, sunlight, and other factors.

If rainfall is not well enough distributed through the growing season, irrigation must be provided if crops are to be grown. Temperature limits the production of many crops; certain crops cannot be grown easily, and some not at all, in the uniform warm temperature of the tropics. Length of day affects the flowering of many crops and the production of starchy roots or tubers. All of these features of the soil and its environment influence the suitability for use, and the limitations, of each kind of soil.

Significance of each of these characteristics and qualities depends greatly on the others, on the kind of crop, and on the kind of management. For that reason a mathematical summation and rating of the qualities of different soils is not practicable, or even possible. The soil scientists and other specialists need to study the characteristics of each kind of soil and the performance of representative soils in experimental plots and in farmers' fields. Then, by comparison of soil characteristics, the results on representative soils can be extended to obtain a good idea of the performance of all the soils in a locality.

D. Soil Groups to Help Remember Soil Characteristics.

The following grouping of soils offers one way to study and to help remember some important facts about each soil series. Major divisions in the grouping correspond with major physiographic divisions of the country, which are the coastal plain, the interior flood plains and depressions, the sandy, gently sloping plains, the hilly or rolling areas, and the mountains and rocky plateaus. For a strictly natural classification of the same soil series, based on characteristics of the soils and not on any outside features, see the last part of section IV, Classification of Soils in Guyana.

Soils of Guyana grouped according to physiographic position and selected soil characteristics.

1. Soils of the coastal plain.

A. Soils in marine clay.

(1) Soft consistence
11 Corentyne
21 Mara
37 Whittaker
44 Weldaad
147 Fairfield

(2) Moderately firm consistence, horizons slightly expressed

13 Skeldon
25 Haswell
30 Macouba
211 Manarabisi

(3) Firm consistence, horizons moderately expressed.

41 Onverwagt
42 Lichfield
43 Rosignol
45 Buxton

B. Soils in alluvial clay or silt.

(1) Firm consistence, horizons faint.

1 De Velde
3 Black Bush
5 Plegt Anker
8 Moleson

(2) Moderately firm consistence, horizons slightly expressed.

31 Canje
31 a Everton
32 Kerkenama
32 a Brandwagt

(3) Firm consistence, horizons moderately expressed.

34 Vryberg
34 a Bath

C. Soils in alluvial clay or silt over marine clay.

(1) Firm consistence in upper layers, horizons faint or moderate.

9 Tain
101 Marinero
36 Brickery
39 Tuschen
100 Inki (over peat)

D. Soils of low sandy or loamy ridges.

70 Novar
72 Ithaca
75 Whim

E. Soils in old silty or clayey sediments of the Coropina geological formation, mostly along inner border of the coastal plain.

(1) Very firm consistence, horizons strongly expressed.

52 Helvetia
152 Cola
53 Kamani
153 Torani
253 Huntley
54 Vigilante
156 Putkin
57 Nassau
157 Potoco
58 Dageraad
158 Yesi

F. Peat and muck soils (pegasse) of the swamps.

20 Anira
220 Baiabo
60 Lama

2. Soils of the generally undulating or gently sloping sandy plains.

A. On uplands.

700 Tiwiwid (White sand, no horizons)
701 Ituni (white sand, dark cemented B horizon)
702 Tarakuli (Dark surface soil, white sand)
712 Wikki (resembles Kasarama, but has thick, dark surface soil)
800 Tabela (brown sand, no horizons, subsoil is sand or loamy sand)
810 Kasarama (brown sand, subsoil is sandy loam or sandy clay loam)
820 Ebini (brown sand, subsoil is sandy clay or clay)
Jacaré (resembles Tabela)
Kwainatta (resembles Tabela)
Emprensa (deep sandy loam)

B. In drainageways or depressions, dark surface soil.

730 Henrietta
732 Siparuta
740 Mibirikuru
742 Wiruni
750 Arima
752 Aroaima

3. Soils of inland depressions, drainageways and flood plains, subject to flooding.

A. Sandy soils.

Ambrose
Makushi
Waruma
Cachoeira
Karanambo

B. Fine textured soils.

Benoni
Burru
Dead Man Swamp
Long Man Swamp (sandy overwash)
Rupununi

C. Undifferentiated alluvial soils.

Detailed classification in many places is not needed, but naming of some series might be justified.

4. Rolling or hilly brown soils, mostly loamy, horizons distinct, underlain mostly by weathered granitic or other light-coloured rocks.

350 Wauna (Gritty sandy loam or loam, sandy clay subsoil)
360 Arakaka (silty soil on fine-grained, mostly foliated rocks)
Durban (loamy soil, kaolinitic substratum)
Ikuribisi (pale, moderately well drained or somewhat poorly drained)
Marabunta Creek (sandy soil over weathered granitic material)
Mountain Point (clay or clay loam over clay or silty clay)
Tirke (on hill-wash fans along Annai-Good Hope mountain front)
Kuma (on gentle colluvial slopes)
Sawariwau (sandy over clay substratum. Stones of quartz and magnetite)
Ireng (on river terraces; silty clay or sandy clay, stratified substratum)

5. Reddish or brown soils, horizons not distinct, generally on basic rocks or ironstone, hilly or mountainous, mostly stony or rocky.

340 Hosororo
Wichabai (resembles Hosororo, but has higher base status)
Tiger Creek (gravelly Regosol grading to Brown Latosol)
Brown Latosol, laterite gravelly phase. To be named.
Lithosol, laterite gravelly phase. To be named.
St. Ignatius (shallow over laterite gravel)
Lethem.
Kaput (on low crests and slopes)

6. Shallow or rocky soils of plateaus and mountains (soil series have not yet been named)

Several series of Lithosols or of rocky soils.

E. Land Capability Classification:

The land capability classification is a grouping of soils according to their general suitability for use, especially the degree and kind of their permanent limitations for producing crops, pasture plants, trees, and other useful vegetation. As the system is applied in Guyana, five general classes, based on the general degree of limitations, are numbered by Roman numerals I through V. Within these broad classes, subclasses are recognized according to the dominant kind of limitation. The subclass is shown by a small letter following the class numeral, such as If or IIm. The system was patterned after one developed in the United States, but differs from that classification in several ways.

The land capability classification is a broad, general grouping of soils. It is useful to persons who want to appraise quickly the farming potential of soils in a large area; to the planners and administrators of an agricultural or other land-use program; and to an agricultural or technical officer who must deal with many kinds of soil and needs to remember the important limitations and the broad requirements for management of each kind. It must be remembered, however, that each kind of soil has a set of characteristics that make it unique, and that precision is lost whenever kinds of soil are grouped in order to generalize about them. The farmer who deals with only a few kinds of soil, and the officer who advises him, need to study not only the capability grouping but also the characteristics, potentialities, and limitations of the particular soils. For many detailed interpretations, the ratings of soils for different crops in section V F will be more useful than the capability groupings.

The capability classification does not take into account the feasibility or cost of drainage of the soils. Unless otherwise stated, soils of the coastal plain are placed in a capability class and subclass according to their permanent limitations after proper drainage. This means that many of the extensive soils, such as those of the De Velde (1), Corentyne (11), Everton (31a), and several other series, are in class I or class II, described as well suited or moderately well suited for cultivation, even though drainage works to drain all the acreage of class I and class II soils might not be feasible.

The point is that almost any area of these soils can be made into good farm land. In contrast, several soils of the interior depressions and flood plains are subject to recurrent flooding, and no significant part of their acreage can be protected from the floods. The risk of flooding is a permanent, non-correctible limitation of those soils, and is reflected in their capability classification.

Irrigation in British Guiana is an optional input in management of many soils, but is necessary for efficient and economical production of some crops. In most places, some crop can be grown during the rainy seasons without irrigation. The capability classification does not indicate the need for or the response to irrigation, which depends neatly on the crop; and it does not reflect climatic hazards such as the risk of drought. These factors, especially the risk of drought and the economic benefit (or possibility) of irrigation, must be evaluated for each farm operation, in relation to the local water supply as well as the soil characteristics.

Soils in capability class I have few limitations except the need for drainage and the need for a good system of management that will build and maintain soil fertility. When drained they are the best soils in the country. Soils in class II have moderate limitations such as low fertility combined with wetness, presence of salts, or very low fertility; all of them require special management if crops are to be grown. Soils in Class III have severe limitations but with proper treatment and precautions will produce crops. Soils in class IV are very severely limited by their natural features, and except in special situations are not suitable for cultivation. Soils or land types in class V are unproductive areas such as rock outcrops, steep, boulder-covered slopes that produce little vegetation, and salt flats along the shore.

In assigning symbols in subclasses, the small letter m denotes physical limitations of heavy soil texture and moderate difficulty in working the soil and obtaining proper drainage; f designates soils for which the chief limitation is low natural fertility and a high requirement for fertilizer and lime; t denotes the probable presence of toxic salts, probably sulphides or sulphates, in the soils that are often called cat clays; s denotes the probable presence of excess amounts of soluble salts, generally chlorides, that would not be toxic in lesser concentration; w denotes wet soils that can be drained only with difficulty or perhaps not at all; and e designates sloping soils on which the risk of runoff and soil erosion are major hazards, although generally there is an acute need also for fertilizer and lime.

Definitions of the land-capability classes and subclasses, and a list of the soils in each subclass, are given in the section that follows. The soils listed are those defined on soil surveys made since 1961.

Class I: Soils in class I have few limitations that restrict their use.

Subclass Im. Clay soils of moderate fertility.

Corentyne clay, 11, 11d, 12
Skeldon clay 13
Onverwagt clay 41, 41d
Lichfield clay 42
Rosignol clay 43, 43d
Burton clay 45

Subclass If. Silty, clayey, or sandy soils, easy to drain and work, moderate or low fertility.

De Velde clay 1c
De Velde silt loam 1s
Black bush clay 3
Plegt Anker clay 5
Moleson silt loam 8
Everton silty clay 31a
Brandwagt clay 32 a
Bath clay or silty clay 34a
Tuschen clay 39
Novar loamy sand 70
Ithaca sandy loam 72

Class II: Soils in class II have moderate limitations that reduce the choice of crops or require moderate conservation or management practices.

Subclass IIm. Clay soils, slowly permeable, low fertility.

Canje clay 31
Kerkenama clay 32
Vryberg clay 34

Subclass IIf. Sandy or silty soils, gently sloping, very low fertility.

Nassau silt loam, 57
Dageraad silt loam, 58
Potoco silt loam, 157
Yesi silt loam, 158
Wikki loamy sand, 712
Kasarama loamy sand, 810 (A slopes only)
Ebini sandy loam, 820 (A slopes only)
Ikuribisi sandy loam (A and B Slopes)

Subclass IIw. Wet clayey or loamy soils, of low fertility, on which drainage is moderately difficult.

Brickery clay 36
Inki clay, 100
Marinero silty clay 101
Helvetia silt loam, 52
Vigilante silty clay, 54
Cola silt loam, 152
Torani silt loam, 153
Putkin silt loam, 156
Manarabisi clay, 211

Subclass IIs. Soils affected by moderate salinity.

De Velde clay, saline phase, 1a
Brandwagt clay, soft substratum phase, 32w.
Onverwagt clay, sandy substratum phase, 41s.
Lichfield clay, sandy substratum phase, 42s.
Rosignol clay, sandy substratum phase, 43s.
Weldaad clay, 44
Buxton clay, sandy substratum phase, 45s.
Fairfield clay, 147
Haswell clay, 25
Tain clay 9
Whim silty clay loam, 75
Whittaker clay, 37

Class III: Soils in class III have severe limitations that reduce the choice of crops, or require special conservation or management practices, or both. They can be cultivated, but with considerable difficulty and high risk.

Subclass IIIm. Organic soils or silty wet soils, difficult to farm if drained.

Anira peat, 20 (if drained)
Lama muck, 60 (if drained)
Baiabo peat, 220 (if drained)
Huntley silt, 253
Kamani silt, 53

Subclass IIIt. Wet clay soils severely limited by toxic salts and low fertility.

Mara clay, 21
Mara clay, peaty phase, 22
Macouba clay, 30
Marinero silty clay, peaty phase, 102

Subclass IIIf. Very sandy soils, low fertility.

Tabela sand, 800, (A and B slopes only).

Subclass IIIw. Wet soils, usable if artificial drainage can be established, otherwise in dry seasons only.

Kamani silt, 53
Mibirikuru loamy sand 740
Wiruni loamy sand, 742
Arima sandy clay loam, 750
Aroaima sandy loam, 752.

Subclass IIIe. Sloping soils of low fertility, subject to erosion.

Arakaka silt loam, 360, A, B, and C slopes
Wauna sandy loam, 350 A, B, and C slopes
Hosororo clay or gravelly clay, 340, A, B, and C slopes (boulders may interfere with cultivation)
Tabela sand, 800, C slopes
Kasarama loamy sand, 810, B and C slopes
Ebini sandy loam, 820, B and C slopes
Durban sandy loam, A, B, and C slopes
Tiger Creek gravelly loam, A, B, and C slopes.

Class IV: Soils in class IV are very severely limited for cultivation. Cultivation is not advisable unless accompanied by extreme treatment to modify or counteract the natural limitations.

Subclass IVf. Extremely sandy or gravelly soils.

Tiwiwid sand, 700
Tarakuli sand, 702
Kamarang gravel (tentative name for Derting's Regosol, laterite gravel phase)

Subclass IVw. Wet soils, undrained (drainage of some is not feasible).

Anira peat, 20 (undrained)
Mara clay, 21 (undrained)
Mara clay, peaty phase, 22 (undrained)
Lama muck, 60 (undrained)
Ituni sand, 701
Henrietta sand, 730
Siparuta sand, 732
Mixed alluvial land, 766

Subclass IVe. Steep soils and shallow or rocky soils. All soils of class D slope (15 - 25 percent) or steeper. (D slopes of some soils can be used for fruit trees with ground cover).

Class V: Soils in class V have limitations that prevent their use for production of ordinary commercial plants.

Subclass Vs

Tidal flats

Subclass Ve

Steep rocky slopes and rock outcrops.

F. <u>Ratings of Soils for Producing Crops</u>

Soils named during and since the 1961-64 soil survey have been rated according to their suitability for producing the common crops. The ratings are shown in the accompanying table and are explained in the section that follows. Soils named on the soil surveys of 1956 and 1957 have not been rated because too little information is available on which to estimate their performance.

Each kind of soil has a large number of physical and chemical characteristics that affect the growth of crops and the responses of different crops to management. The soils best suited for rice, for example, are free of toxic chemicals, are fine textured and slowly permeable, are well supplied with plant nutrients or are responsive to fertilizers, and are in places where water can be held on the soil when desired, but drained away when it is time to prepare the soil or harvest the crop. Most crops, in contrast, do best in a soil that can be kept moist but not wet in the root zone, is well aerated, and contains a good supply of plant nutrients or holds in available form those that are applied in fertilizer.

The ratings of soils according to crop suitability are more specific than the land-capability groupings. Separate ratings are given for 21 different crops or groups of crops. The capability grouping, in contrast, is a general rating based on the general capability and limitations of the soil when it is cultivated, including the risk of soil erosion and the need for practices to control runoff water. A soil that has a high or moderately high suitability rating for bananas or citrus can be in capability Class I if it is nearly level; another soil, almost equally good for bananas or citrus, but sloping, can be in capability Class II or III because erosion must be controlled to produce crops year after year. The ratings for individual crops are more useful than the capability groupings to a farmer or to someone who wants a brief and very general summary of the crop-producing potential of the soils in a locality or a region.

In making the ratings of suitability for crops, several assumptions have been made, and certain principles have been taken as guide lines. The following assumptions and guides should be kept in mind when using the ratings.

1. It is assumed that crops will be grown with at least a moderate level of management; that lime and fertilizers will be used according to soil tests and needs of the crop; and that runoff and erosion will be controlled if the soil is sloping. This is a level of management that can be followed readily by a good farmer. A very high level of management, such as that practiced on the Government Agricultural Stations and the sugar estates, is not assumed.

2. It is assumed that main drainage and irrigation works are installed where necessary. Adequate irrigation and water control is implied, for example, by a rating of 1 or 2 for rice.

3. For a rating of 1 or 2 (well suited or moderately well suited) it is assumed that the cost of the management necessary to grow the crop (including farm, drainage and irrigation where required) is less than the returns that can normally be expected. That is, over the long run the value of the crop is expected to exceed the cost of producing it. Detailed economic studies have not been made, however, and the ratings will need to be improved from time to time whenever new data become available.

4. The ratings are based on presently known levels of agricultural technology. As technology advances the ratings might need to be changed.

5. Most of the ratings were made in 1961-64 by a group of soil scientists after consultation with local and international specialists. Many differences of opinion were brought forth, but every effort was made to obtain a reasonable consensus. The ratings therefore must be regarded as general guides rather than precise evaluations of expected yields. In particular, new or untried crops, or familiar crops on soils where experience is lacking, should be planted first in field trials or on a pilot farm.

6. The list of crops cover only those that are widely grown or that have been considered for commercial production. Absence of a crop from the list should not be taken as indicating any lack of suitability.

7. Under an extremely high level of management, applied with unusual skill, satisfactory but often not economic yields of crops can sometimes be obtained on highly unfavourable soils. The ratings do not reflect any such extreme level of management.

The table shows four levels of suitability of crops for the different soils, designated by the numerals 1, 2, 3, and 4. Significance of the levels is explained as follows:

1. Well suited. With a moderate or better degree of management as defined in the preceding paragraphs, the crop grows well and produces moderate or high yields. For the crop named, the soil has favourable physical characteristics, can be brought to a reasonable level of fertility, and is responsive to good management.

2. Moderately well suited. With about the same level, but not necessarily the same kind of management as described for class I (well suited), the crop can be expected to produce moderate yields. The soil may have only moderately favourable physical or chemical characteristics for the crop named, or it may be only moderately responsive to good management.

3. Poorly suited. With a moderate or better degree of management, about the same level, but not necessarily the same kind as described for Class I, the crop produces only poor yields. Response to management is generally low. Soil factors such as wetness, water-holding capacity, supply of plant nutrients, toxic salts are unfavourable for the crop named.

4. Not suited. With a moderate or better degree of management, about the same level, but not necessarily the same kind as described for Class I. (Well suited), little if any production of the named crop can be expected.

Insofar as generalization is possible, a rating of 1 or 2 suggests that economic production of the crop can be achieved with a moderate or high level of management. A rating of 3 or 4 suggests that as a rule commercial production of the crop should not be attempted.

Only two ratings are given for cotton. Little is known about either the technology or the economics of this crop, although the plants are grown as perennial shrubs in most parts of the country, and some cotton has been grown under irrigation on experimental plots of Kasarama loamy sand (810 grading toward 800) at the Ebini Station. A rating of 2 indicates that the soil characteristics are generally favourable for cotton, although performance of the crop in this climate is yet to be evaluated. A rating of 4 indicates that the soil characteristics are generally unfavourable. Greater precision in the ratings is not possible at this time; the ratings should be revised and made more precise as further experience with the crop is obtained.

Suitability of soil for the crop is only one of the many factors in the complex technology of producing crops of high quality at a profit. On nearly all the soils of Guyana, deficiencies in plant nutrients must be made up through additions of fertilizer and lime. Maintenance of organic matter, the growing of cover crops to shade and protect the soil, and the maintenance of good soil structure are interrelated practices of soil management. Runoff and erosion need to be controlled on sloping soils. Control of water is essential, especially if the soil is one that requires artificial drainage or the crop is one that requires irrigation. Each crop also has its own special requirements; among them the selection of a good variety, proper timing of all operations, and control of pests and diseases. Knowledge of the soil and its limitations is essential, but is only part of the knowledge and skill needed for production of good crops.

RATINGS OF SOILS FOR PRODUCTION OF MAJOR CROPS

Name of soil	Map Symbol	Suitability for - Rice	Sugar cane	Coconuts	Oil Palm	Citrus	Cocoa	Bananas	Ground Prov.	Tomatoes & veg.	Onions	Pineapples	Blackeye peas	Soybeans	Maize	Cotton	Pasture	Sesame	Peanuts	Grain sorghum	Tobacco	Cashew Nuts
Anira	20	4	4	4	4	4	4	4	3	3	4	3	4	4	4	4	3	4	4	4	4	4
Arakaka	360	4	3	1	1	1	3	2	2	2	2	1	2	2	2	2	1	2	3	2	2	1
Arima	750	4	4	4	4	4	4	4	2	3	3	4	2	2	4	4	2	2	4	4	2	4
Aroaima	752	4	4	4	4	4	4	4	2	3	3	4	2	2	4	4	2	2	4	4	2	4
Bath	34a	2	1	3	2	2	2	2	2	2	3	1	1	1	1	2	2	2	4	4	4	4
Black Bush	3	1	1	3	2	2	3	2	1	1	2	2	2	2	2	2	1	2	3	2	4	4
Brandwagt	32a	2	1	2	2	2	2	2	1	2	3	1	1	1	1	2	1	2	3	1	4	4
Brandwagt, soft substratum	32w	2	2	2	3	3	4	2	2	3	3	2	3	3	2	4	2	3	4	2	4	4
Brickery	36	2	2	2	3	2	3	2	2	2	3	1	2	3	2	4	2	3	4	2	4	4
Buxton	45	1	2	2	2	2	3	2	1	2	2	1	2	2	1	2	2	2	3	1	4	4
Canje	31	2	2	3	4	2	3	2	2	3	4	2	2	2	3	2	2	2	4	3	4	4
Cola	152	3	3	3	2	3	3	3	2	2	2	1	2	2	3	4	2	2	4	3	4	4
Corentyne	11	1	1	3	2	2	3	2	1	1	2	2	1	1	2	2	2	1	4	2	4	4
Dageraad	58	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	3	2	4	4
De Velde Silt loam	1s	2	1	2	1	1	2	2	1	1	2	1	1	1	1	2	2	1	4	1	4	4
De Velde Clay	1c	1	1	2	1	2	2	1	1	1	3	2	3	1	1	2	2	1	4	1	4	4
De Velde Clay saline phase	1a	1	2	2	1	2	4	3	1	2	3	2	4	4	2	4	2	3	4	2	4	4
Ebini	820	4	2	1	1	1	3	3	2	2	2	1	2	2	3	2	2	2	2	2	1	1
Everton	31a	2	1	2	1	1	1	2	1	2	3	1	1	1	1	2	2	2	4	1	4	4
Fairfield	147	1	2	2	3	3	4	2	2	3	3	3	3	4	3	2	2	3	4	3	4	4
Haswell	25	1	2	2	3	3	4	3	2	3	3	3	4	4	3	2	2	3	4	3	4	4
Henrietta	730	4	4	4	4	4	4	3	3	3	4	4	4	4	4	4	2	2	4	4	4	4
Helvetia	52	4	3	3	2	3	3	3	2	2	2	2	3	2	3	4	2	2	3	3	4	4
Hosororo	340	4	3	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2
Huntley	253	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4
Inki	100	2	2	3	4	3	3	3	2	2	3	2	3	3	3	4	2	3	4	3	4	4
Ithaca	72	4	3	1	1	2	3	3	1	1	1	1	2	2	2	2	2	2	2	2	4	4
Ituni	701	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Kamani	53	4	4	4	4	4	4	4	3	3	3	3	4	4	4	4	3	4	4	4	4	4
Kasarama	810	4	2	1	1	1	3	4	2	1	1	1	2	2	3	2	2	2	2	2	1	1
Kerkenama	32	2	2	3	2	2	3	2	2	3	3	2	2	2	2	2	2	4	3	2	4	4
Lama	60	4	4	2	4	3	4	4	2	2	2	2	4	4	3	4	4	4	4	4	4	4
Lichfield	42	1	1	2	2	2	1	1	1	1	2	1	2	1	1	2	1	1	3	1	4	4
Macouba	30	3	3	4	4	4	4	3	2	3	4	3	4	4	4	4	4	4	4	4	4	4

RATINGS OF SOILS FOR PRODUCTION OF MAJOR CROPS (continued)

Name of Soil	Map Symbol	Suitability for -																				
		Rice	Sugar cane	Coconuts	Oil Palm	Citrus	Cocoa	Bananas	Ground Provisions	Tomatoes & veg.	Onions	Pineapples	Blackeye peas	Soybeans	Maize	Cotton	Pasture	Sesame	Peanuts	Grain sorghum	Tobacco	Cashew Nuts
Manarabisi	211	1	2	3	2	3	3	2	2	2	2	2	2	2	3	2	2	1	4	3	4	4
Mara	21	4	4	4	4	4	4	4	3	3	4	3	4	4	4	4	3	4	4	4	4	4
Marinero	101	3	3	3	3	3	3	3	2	3	3	2	3	3	3	4	2	3	4	3	4	4
Mibirikuru	740	4	4	4	4	4	4	4	2	2	2	4	2	2	4	4	2	2	4	4	2	4
Moleson	8	3	1	1	1	1	2	2	1	1	1	2	1	1	1	2	2	1	3	1	3	3
Nassau	57	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	3	3
Novar	70	4	3	1	1	2	3	3	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Onverwagt	41	1	2	3	2	2	3	2	2	3	3	2	2	2	2	2	2	3	3	2	3	3
Plegt Anker	5	1	2	3	2	2	3	2	1	2	2	2	2	2	2	2	2	2	3	2	3	3
Potooo	157	4	2	2	1	2	2	2	2	2	2	1	2	2	3	2	2	1	2	2	3	4
Putkin	156	3	3	3	2	3	3	3	2	2	2	1	2	2	3	4	2	2	3	2	3	4
Rosignol	43	1	2	3	2	2	3	2	1	2	2	2	2	2	2	2	1	2	3	2	4	4
Siparuta	732	4	4	4	4	4	4	4	3	3	3	4	4	4	4	4	2	4	4	4	4	4
Skeldon	13	1	1	3	2	2	3	2	1	1	2	2	1	1	2	2	2	1	4	2	4	4
Tabela	800	4	4	3	4	4	4	4	4	3	3	2	4	3	4	4	4	4	3	4	3	3
Tain	9	1	2	3	2	3	4	3	2	3	3	3	3	4	3	2	2	3	3	3	4	4
Tarakuli	702	4	4	3	4	4	4	4	4	3	3	2	4	4	4	4	4	4	3	4	3	3
Tiwiwid	700	4	4	3	4	4	4	4	4	3	3	2	4	4	4	4	4	4	4	4	3	3
Torani	153	3	2	2	2	3	3	3	2	2	2	1	2	2	3	4	2	2	4	3	3	4
Tuschen	39	2	1	2	3	1	2	1	1	2	3	1	1	2	1	4	2	2	4	2	4	2
Vigilante	54	3	3	3	2	3	3	2	2	2	3	2	3	2	3	4	2	2	4	3	3	4
Vryberg	34	2	2	3	2	2	3	2	2	3	3	2	2	2	3	2	2	3	4	3	3	4
Wauna	350	4	3	3	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	1
Weldaad	44	1	2	2	3	3	4	2	2	3	3	3	3	4	3	2	2	3	4	3	4	4
Whim	75	2	2	2	3	3	4	3	2	3	3	3	3	4	3	2	2	3	4	3	3	4
Whittaker	37	1	2	3	2	3	4	3	2	3	3	3	3	4	3	2	2	3	4	3	4	4
Wiruni	742	4	4	4	4	4	4	4	2	2	2	4	2	2	4	4	2	2	4	4	2	4
Yesi	158	4	3	2	1	2	2	2	2	1	2	2	2	2	2	2	2	1	4	2	4	4

G. Suggestions for Soil Management:

All soils require management if crops are to be produced. The soil must be cleared and kept free from unwanted plants. Some soils must be drained. The soil must be prepared and the crop must be planted. Practices to obtain good physical condition - often called good tilth - of the surface layer are needed on many soils. Most crops in British Guiana will respond to applications of fertilizers and lime; on many of the soils fertilizer is essential if crops are to be grown year after year. Irrigation is profitable on many crops and soils and is necessary for economical production of some crops, especially rice and sugar cane.

Water Control:

In the coastal plain, control of water is necessary for any programme of development. Most of the soils there are subject to flooding during the rainy season, and are likely to be too dry for good crop growth during the dry season. Low areas near the coast and along the river need to be protected from flooding by high tides.

The land-capability classification of the level, naturally wet soils of the coastal plain (generally those having numbers under 150) reflects potentialities and limitations of the soil after an adequate drainage system has been installed. No judgement has been made or implied about the engineering feasibility or the economic justification of any drainage or flood-control project. The objective is to point out and to group the soils according to their inherent limitations that will persist after systems for drainage and flood control have been installed.

On upland soils and on soils of the low interior areas, the natural wetness and the possibility of correcting it are factors considered, along with all the other soil characteristics, in the capability classification. The classification does not take into account the factor of water supply or the practices required to bring water to the field. Responses of a crop to irrigation on any of the soils might be inferred in a general way from the capability classification of that soil, but should be studied specifically in relation to the soil characteristics and the needs of the crop.

Soil Erosion

Nearly level soils of the coastal plain require drainage but have little or no hazard of soil erosion. Soils of the uplands, including many that lie on slopes of only 1 or 2 percent, are erodible and need practices to control the speed of runoff water. Most farmers of the coastal areas are not aware of the problem of erosion and have not learned to live with it. The risk is great that if those farmers move to sloping soils, they will follow destructive farming methods and will not see what is happening until much of their good soil has been lost. The practices of mulching, growing cover crops, contour farming, planting barriers, keeping waterways covered with vegetation, and many others to check losses of soil and water must be made the normal practice on sloping fields. Agricultural Officers need to guide the selection of crops and of farming systems so that the soils will be maintained and improved, and not allowed to wash away.

Acidity, salts, and toxic sulphates:

According to Cate in the report of soil surveys and related work done in 1961-64, three major types of chemical problems are likely to be present in many soils of British Guiana.

Most widespread is the problem of soil acidity, which is almost always a sign of low base saturation; if an extremely acid soil contains more than about 40 percent clay, it can also contain a toxic amount of soluble or exchangeable aluminium. Lime will correct the soil acidity, but other nutrients, especially potassium and magnesium are needed in many soils. Phosphorus and nitrogen are needed also in many soils, although the need for them is not shown especially by strong acidity or a low level of exchangeable bases.

Another problem, present in many soils near the coast, is salinity; that is the presence in toxic amounts of the neutral salts that are in sea water, which are mainly chlorides and sulphates of sodium and magnesium. Good drainage, to permit leaching by rain water or irrigation, will help bring the salt content down to a safe concentration. Crops vary in their tolerance to salts, and much depends on nature of the soil. Later flooding by salt water of course should be prevented.

A serious problem is caused in soils that contain iron sulphates, which if they are oxidized produce sulphuric acid. The acid in turn reacts to produce toxic iron sulphate and aluminium sulphate. Although the toxic sulphates can be controlled by putting on an enormous amount of lime or by flooding with sea water and then leaching the excess salt, those treatments are likely to be too costly for widespread use. Soils that contain toxic sulphides or sulphates are often called cat clays. As a rule they should be avoided for cultivation, although cat clay in the lower subsoil does not always prevent a good crop of rice or a productive pasture.

The chemical problems discussed here are interrelated, and the help of an Agricultural Officer should be sought if a problem of excess salt or of toxic sulphates is suspected. It is more than likely that he will want to have soil samples analysed from the problem places.

<u>Fertilizer and Lime:</u>

Only the soils listed in capability subclass Im are likely to produce crops for more than a few years without added fertilizer. Even on those soils, especially after a few years of cultivation, many crops will respond to fertilizer. On many soils, for example of Kasarama loamy sand (810), fertilizer and lime, including small amounts of some of the minor elements, must be put on the soil if a crop or a successful pasture is to be grown. The selection of fertilizer depends on the kind of soil, the crop to be grown, and the history of the field. The help of an Agricultural Officer should be obtained; without the help of a trained person, it is possible to spend money needlessly for the wrong kind, for too much, or for too little fertilizer.

<u>Physical properties of soil:</u>

Soil textural classes, natural soil structure, and the induced soil structure of a cultivated field that is called soil tilth, all vary enormously in different parts of the country. Soil texture cannot be changed, except by mixing soil on a small scale as in a flower bed, and even then at considerable expense. Texture often influences the choice of a crop; for example rice can generally be grown best on a clay soil, and peanuts do best on a sandy soil.

Some crops grow well on a wide range of soil texture, but their culture brings up special problems if the soil forms hard clods or if it is extremely sandy and loose.

Soil structure in the surface layer can be modified to some extent by cultural practices. The responses differ greatly, however, on different soils. Some (not all) clays and clay loams can be brought into good tilth; that is, stable granular or crumbs can be developed, and the soil then can be cultivated over a fairly wide range of moisture content. Generally, a good supply of organic matter helps promote good tilth; but the effect is lost as the organic matter decays. A soil with high silt content, in contrast, has weak structure and also tends to form a crust after a rain. Extremely silty soils flow easily when wet, and are called catch-cow soils. Granulation of many clay soils can be improved by flood fallowing where that is practicable.

Both texture and structure affect permeability of soil horizons beneath the cultivation surface soil. A soil that is moderately or rapidly permeable drains easily. A slowly permeable soil is more difficult to drain, and requires drains more closely spaced. Structure and permeability of some subsoils can be improved by growing deep-rooted crops. Tilth of the cultivated layer in most soils can be improved by use of crop residues and mulches; by cultivating when the soil is neither too wet nor too dry; and by following a good program of soil fertility, especially if deficiencies or imbalances are present that need to be corrected.

<u>Cropping systems</u>:

Cropping systems need to be developed to fit the different soils. It is likely that some would increase total production, or cut costs, or both. A rotation of rice with soybeans, blackeye peas, pasture, or some forage crop, for example, along with improved fertility and careful irrigation, might give increased yields of rice per acre; and enable a farmer to produce as much rice as before, plus the extra crop or the pasture. There must of course be a market for the extra crop or livestock that would be produced, and the farmer must be willing and able to arrange for the necessary work to be done.

Total returns from many fields can be greater from a mixture of crops than from a single one. Coconuts and bananas, coconuts and pasture, citrus and pasture, or coconuts and annual crops might be profitable combination. Corn in many places is a crop of doubtful profitability; mixed plantings of corn with a suitable legume might yield more feed per acre (and better feed) than either crop alone. These are only suggestions. The Agricultural Officer will need to plan many cropping systems to fit the different soils, supply the existing or developing markets, and meet the needs of many individual farmers.

<u>Analysis and testing of soils</u>:

Soils are analysed in the laboratory for two main purposes; to obtain knowledge of their characteristics and help explain their genesis, and to interpret the behaviour of plants and especially the need for additions of plant nutrients or of lime. In a modern soil laboratory the same or similar methods can be used for both objectives. An analysis for soil characterisation generally includes more items, however, than a soil test intended mainly to explain crop behaviour or to give a basis for recommending fertilizer and lime.

Soil sampling and soil analysis are essential parts of soil survey operations. The procedure of soil surveys and the use of soil samples, however, are not well understood by some scientistis in disciplines other than soil science.

Soil types are identified and soil mapping units are mapped almost entirely on the basis of characteristics that can be identified in the field or measured there with simple tests. The soil scientist examines soils in pits to learn and record characteristics of their horizons, and in auger borings to learn a few characteristics that generally permit mapping units in a restricted locality to be set apart one from another. A field pH kit to measure soil reaction, and a bottle of dilute acid to test for carbonates are standard soil survey equipment in most parts of the world. The acid bottle is seldom needed in Guyana since nearly all of the soils here have long ago been leached free from soluble carbonates. An auger or spade or both, to reach subsoil horizons, and a hand level to measure slopes, are indispensable items of equipment for the soil surveyor.

After the kinds of soil in a designated area have been described and classified, and much of the soil mapping to show their extent and distribution has been done, samples are taken of each horizon in at least one representative profile of each soil series. Each horizon that is sampled is also described with care.

The soil surveyor, therefore, does not ordinarily take many soil samples in the regular course of his work from day to day; but spends most of his time plotting soil boundaries. He collects samples from one or more representative profiles of each major kind of soil near the end of his work in a designated soil survey area.

Every soil is a natural body on the surface of the earth, in an environment that in most places changes with the seasons; and it possesses a large number of interesting characteristics. Physical or chemical analysis of a sample taken from one soil horizon therefore gives only fragmentary information about the total nature of the soil. Soil analysis of course is extremely valuable in setting one soil apart from another and in explaining the performance of crops or other plants, but we should remember that the best analytical methods give only a small part of the information that might be desired.

In characterising soils of Guyana, the following physical and chemical data are ordinarily obtained.

Particle size distribution: Sand, silt, and clay by pipette method, after oxidation of organic matter and dispersion with sodium hexametaphosphate.

Reaction, measured by glass electrode and expressed as pH value.

Organic carbon.
Total nitrogen.
Available phosphorus, by Truog method.

Soluable salts: Total amount expressed as parts per million of soil. Sulphates and chlorides, if significant, expressed as milliequivalents per 100 grams of soil. Soluble acidic and basic constituents, expressed as milliequivalents per 100 grams of soil.

Extractable hydrogen, with KCl and with triethanclamine; expressed as meq. per 100 grams of soil.

Extractable bases; Ca and Mg displaced by KCl, K and Na displaced by KCl, K and Na displaced by acetic acid, expressed as meq. per 100 grams of soil.

Exchange capacity, calculated by adding extractable bases to (1) KCl acid and (2) TEA acid.

Percentage of base saturation, calculated fron exchange capacity by sum of bases plus KCl acid.

For samples taken in extension work, particle size distribution and TEA acid ordinarily are not determined. Exchangeable hydrogen extracted by KCl has been found more useful than that by TEA in making estimates of lime requirement. Soluble salts are measured wherever salinity is believed to be significant; many of the samples are taken because of suspected difficulty with excess salts.

Expansion of laboratory services to permit better physical characterisation of soils is needed. Equipment should be obtained and methods installed for at least the following measurements:

Bulk density.
Moisture retained at 1/3 atmosphere and at 15 atmospheres of tension.

Such data by soil horizons permit calculation of the capacity to hold moisture available to plants in the root zone, and will be especially needed if crops are grown under sprinkler irrigation on any of the sloping, loamy soils.

Data on clay minerology should also be obtained, if possible, on samples from the profiles of several representative soils. Such data might be obtained most economically by participating in some kind of international project rather than by purchasing and operating the equipment of Guyana. Data on clay mineralogy will add greatly to the presently available information about soil characteristics and soil genesis.

<u>Summary of suggestions for use of soil maps and reports</u>:

Recognizing that facts about soil are essential for orderly development, Guyana has accepted an investment of more than a million dollars in modern soil surveys. It is necessary now to make a small continuing investment to conserve the results of the soil surveys, keep them available, and apply them to the changing requirements. A well trained, able soil survey staff is available to interpret the soil maps and data already obtained, to make new soil surveys, and to carry on related field trials and laboratory work. These combined efforts in soil mapping, studies of soil performance, and characterization of soils in the laboratory, are essential parts of a balanced program of soil research.

The soil survey staff, and other officers who deal with related research and extension, are key people in the complicated process of obtaining good returns on this big investment. Continuing work is needed along at least six major lines, as suggested in the paragraphs that follow. Some of this work is the major responsibility of the soil survey staff. Some is done by other officers or specialized groups within the Ministry of Agriculture. Some, especially the applications of soil information on forest lands and in Amerindian villages, is done mainly by officers in ministries other than Agriculture.

1. Make new soil surveys. This scientific and technical work has been treated at length in the longer sections of this report. The mapping and correlation of soils in new areas present ever-changing challenges to the scientific staff. Problems and successes of farmers keep the soil survey staff and other specialists responsive to changing needs.

2. Study continually the reports of past soil surveys. It is evident that the professional staff in Guyana needs to be more familiar than they are at present with the published and unpublished results of soil surveys and related data. Potential users of soil information can make many uses of published maps, reports, and summaries, but they often need professional help in defining their soil problem and finding the best answers. The Soil Surveyor and his staff should be required to know the contents of available soil maps and reports, and to extract or summarize from them on short notice the soil information that applies to particular problems.

To permit this kind of service, the soil scientists must have time for study and reflection; and the soil survey maps, reports, results of field trials, and laboratory data must be preserved in accessible places and forms.

3. Classify and correlate soils, and study soil characteristics. Field studies of soils, analyses of soils in the laboratory, and studies of the responses when soils are used, are complementary phases of soil research. Correlation of soils, after study of their characteristics, establishes for each kind of soil a name and a place in the system of soil classification. The mapping and related studies of soils naturally result in publications; not only of soil survey reports and maps, but of scientific papers by which major results of the research are made available to professional colleagues in all parts of the world.

4. Obtain and interpret data on responses to management of named kinds of soil. As brought out in more detail elsewhere, the need for practical interpretations is the main reason why governments all over the world are willing to invest in soil surveys and related research.

5. Provide information about soils of development projects, and about implications of soil data that might influence decisions regarding policy or operations in land use or development. It is eseential that the Soil Surveyor in person should take part in discussions with other specialists, especially in disciplines such as engineering, forestry, economics, and sociology. Only through such direct participation can the groups of specialists arrive at workable sets of alternatives to give the policy-makers a basis for decisions.

6. Interpret soils for the regular work of agricultural officers and Assistants. The regular use of soils information, and especially for soil maps where they are available, needs to be greatly strengthened. Agricultural Officers and Assistants need to be aware of the differences in soils, and able to recognize the major kinds of soil in their areas. They must recognize also the limitations of a soil map of medium intensity; especially the described range of characteristics of each named kind of soil, and the probability that many soil mapping units contain inclusions of soils other than the one that gives the mapping unit its name.

Reference materials, on particular kinds of soil or on the soils of a given locality, are needed for use by extension workers and by interested farmers. These can consist of descriptions of the soils (as far as possible in non-technical language), statements about uses of the soils responses of crops, and suggestions for management and conservation of particular kinds or groups of soils. The possibilities for such leaflets and guide sheets are almost endless. Extension workers should study the need and ask for materials that will help spread the knowledge about soils.

Members of the soil survey staff also need to be involved directly in answers to soil questions on specific farms that come up during the regular extension work. Sampling of soils as a basis for soil-management advice should be done, if practicable by a member of the soil survey staff; otherwise by an extension officer or assistant who has been trained to take soil samples, to read the soil map if one has been made, and to record facts about the soils, the cropping history, and the planned cropping system. If good information on these items is furnished, the Chemist or other responsible officer can interpret the soil analysis, and make useful, practical recommendations to help the farmer obtain the desired responses from his soils.

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APPENDIX

DESCRIPTIONS OF SOIL SERIES

CONTENTS

INTRODUCTION

Descriptions of the soil series classified in British Guiana have been prepared in the format adopted in 1965 by the United States Soil Conservation Service. Each description gives major characteristics of the soils in the series, the range of characteristics within the concept of the series in 1965-1966, and important differentiaefrom other series.

Soil Survey field parties will study these descriptions and will classify in the proper series each soil that is observed and mapped in the course of their work. The field party prepares a mapping legend in an early stage of each soil survey. Addition to the mapping legend may be made in tentative form by the party chief, to be confirmed by the Soil Surveyor or his designated representative after study of the notes and inspection of the soils in the field.

The range of characteristics of any soil series may be extended or restricted by the Soil Surveyor as new data are obtained. Generally, the range will be extended if other soils with slightly different morphology are found to have closely similar genesis and responses to treatment; and will be restricted if experience reveals a spread too wide, especially in responses when the soils are used and managed. Whenever an approved description is changed, a new description which states clearly the new range of characteristics and the differentiae from competing series will be substituted in the Soil Survey records and circulated to the Soil Survey Staff and to others interested.

To establish a new soil series, the Soil Surveyor approves and releases the description of it. Any member of the staff may propose a new series, and should support the proposal with a draft description prepared in the standard form.

New soil names are not to be used in soil survey reports, in correspondence, or in any documents intended for the public, until the Soil Surveyor has approved the name and the series description.

In the descriptions that follow, the first sentence gives the name of the series and its classification in the new system now coming into use in the United States. Next are the class of natural soil drainage and the great soil group in the soil classification that was given in Soils and Men, the U.S. Yearbook of Agriculture 1938, modified to some extent in later papers. The first paragraph also contains a short description in general terms of a norm for soils of the series.

Headings introduce a description of a typical profile (part of a typifying pedon), a statement of the type location, the range in characteristics, names of competing series and their differentiae, the setting in terms of physiography, land forms, geology, and climate, the principal associated soils, drainage and permeability, use and vegetation, distribution and extent, date and place where the series was established, remarks, if any, initials or name of the compiler, and date of the latest revision.

All placements in the new soil classification are subject to review and correction. Placements in orders, suborders, groups, and subgroups of soils named in the U.N. Soil Survey were made by Glenn H. Robinson in 1963 and early 1964, and were adjusted by J. G. Steele in 1965 to conform with the changes circulated in draft form to members of the United States Soil Survey in June, 1964. Placements in families of all the series, and classification of the series described in three published reports of the Regional Research Centre were estimated by J. G. Steele in 1965. Because all statements about the new classification are tentative and subject to correction, few statements have been made about reliability of the placement of each series.

Descriptions of soil series, even after they have been approved by the Soil Surveyor and circulated among the Soil Survey Staff and other technical people, are subject to review and change as soil research, including soil mapping, is carried on. Two soils considered different enough from each other to be members of two series might be found on study and analysis to be within the range allowable for one; and soils first classified in one series might be found to cover a range broad enough to require classification and definition of two or more series. New soil series will be discovered and described as soil surveys are made in new areas. The resulting changes in soil nomenclature are troublesome, but cannot be avoided as soil classifications and soil technology move forward.

Ambrose Series

The Ambrose soils are members of a fine loamy, isothermal family of Oxic Ochraquults. They are also classified as Low Humic Gley soils grading to Red-Yellow Podzolic soils, and are somewhat poorly drained. The surface soil is dark greyish brown loamy sand, the upper subsoil is greyish brown loamy sand, and the lower subsoil is light brownish grey sandy clay loam grading to sandy clay, containing small iron concretions and faintly mottled.

Typifying pedon:

0 - 6" - (10YR 4/2) dark greyish brown loamy sand; structureless; roots common.

6 - 21" - (2.5Y 5/2); greyish brown loamy sand; structureless; few roots.

21 - 50"+- (2.5Y 6/2); light brownish grey sandy clay loam increasing to sandy clay; rare small Fe concretions; common faint yellow mottling.

Type location: Rupununi Savannahs in Southwestern British Guiana.

Range in Characteristics: Not available in 1965.

Competing series and their differentiae: Not stated in the description available in 1965.

Setting: The Ambrose-Dead Man Swamp Association occupies the lowest lying region of the undulating country near the Takutu and the Sawariwau Rivers. The two soils are the bottom members of a topographic sequence. Ambrose soils occupy the low crests and slopes just a foot or so above the depressions in which there are Dead Man Swamp soils. About 63 percent of the association is occupied by Ambrose soils.

Principal Associated soils: Dead Man Swamp soils are on adjacent gentle slopes that lead down to the drainageways.

Drainage and Permeability: Somewhat poorly drained; probably moderately permeable. Water table was at 30 inches in December.

Vegetation and Use: Vegetation is savannah grasses and shrubs; Trachypogon plumosus (velvet grass variant) and Byrsonima verbascifolia occupied the typifying pedon. The soils are flooded in the wet seasons and become very dry in the dry seasons and so are difficult to use. Samples contained cobalt, which is deficient in many other soils of the section. The forage produced should help to overcome deficiencies of that element.

Distribution and Extent: Ambrose soils occupy about 75 square miles in the section covered by the soil survey of 1958. Further extent is not known in 1965.

Series Established: Soil Survey of Rupununi Savannahs, published 1958.

Remarks: The attempt to restrict each soil series to a definite land form will need to be re-examined. Internal characteristics and the range of characteristics in Ambrose soils need to be defined.

Source: Soil Survey of the Rupununi Savannahs, Soil and Land Use Surveys No. 2, British Guiana, by Regional Research Centre of the ICTA, Trinidad, March, 1958. Arranged in this form by J. G. Steele, November, 1965.

Anira Series 20

Soils of the Anira series are organic soils, classified as Histosols in the new classification and as Bog soils in the great soil groups of 1938. They consist of dark brown or dark reddish brown acid peat at least 30 inches deep, underlain by alluvial silts or clays, or by soft marine clay.

Typifying pedon: Representative profile of Anira peat.

O11 — 0 - 16" — Dark reddish brown (5YR 3/2) raw peat consisting of living roots and decaying vegetation; distinct smell of H_2S; extremely acid; abrupt, smooth boundary.

O12 — 16 - 34" — Dark brown (7.5YR 3/2) peat, more decomposed than above horizon; fine roots throughout; smell of H_2S; thin horizon of dark greysh brown clay about ½ inch thick; extremely acid; clear, smooth boundary.

O13 — 34 - 47" — Dark reddish brown (5YR 3/2) woody peat; smell of H_2S; very strongly acid; clear, smooth boundary.

Clg — 47 - 66"+ - Greenish grey (5BG 6/1) clay with some peat at the top and numerous organic specks below, very soft; massive structure; sticky and plastic; moderately alkaline.

Type Location: The representative profile was described and sampled 1 mile east of the Berbice River and 5 miles north of Mara, in northeastern British Guiana.

Range in Characteristics: The degree of decomposition varies, but in most places the nature of the original plant material can be identified. The peat is extremely acid. The underlying mineral soil consists of alluvial sediments or of soft marine clay. Either kind of material has in some places a high content of acid sulphates.

Competing series and their differentiae: Anira peat is more acid and retains more structure of the original plant material than Lama muck (60). A variation, in which the peat is underlain at 36 to 48 inches by a layer of dense "catch cow" silt, was mapped separately and given the name of Baiabo peat (220). It is recommended that the name Baiabo can be dropped, and that soil can be named as a silty substratum phase of Anira peat.

Setting: Anira peat occurs in large swamps, in many places bordered or underlain by sediments of Coropina age. The areas are covered with water unless they have been artificially drained. Some are used for water conservancies.

Principal Associated soils: In many places Mara soils (21) lie along the edge of the peat swamp. Canje (31), Kerkenama (32) and other soils in alluvial or in marine sediments generally lie on the seaward side of the peat swamps. On the inland side, and in some places as islands in the peat, are Putkin soils (156) or other soils in silty sediments of the Coropina formation.

Drainage and Permeability: Very poorly drained; saturated unless artificially drained. Permeability is variable.

Vegetation and use: Vegetation in most places is swamp forest. Anira peat has low suitability for cultivation. If drained, the peat is likely to shrink as much as 50 percent; then control of water is extremely difficult. Fire is a serious hazard after drainage, and the burned residue is likely to contain toxic aluminium. Toxic aluminium, sulphates, or both, are present in many places. With drainage and a high, costly level of management, some crops might be grown. Capability Subclass after drainage, IIIm.

Distribution and Extent: Anira peat occupies more than 130,000 acres in the areas covered by detailed soil surveys, and approximately 200,000 acres more in the northeastern coastal plain; also, probably, the major part of more than 1,700,000 acres of peat and muck soils in the coastal plan of the Northwest District.

Series established: Soil Survey, Mahaica-Mahaicony-Abary Area, 1962.

Remarks: Classification within the order of Histosols should be completed after criteria for the suborders, groups, and subgroups have been established.

Source: Soil Survey of Canje area, and of Mahaica-Mahaicony-Abary area; released in preliminary form, 1964. Compiled in this form by J. G. Steele, January, 1966.

Arakaka series 360

The Arakaka series consists of soils classified as members of a deep clayey family of Oxic Normudults, (well drained, Red-Yellow Podzolic soils). Arakaka soils typically have a brown or dark greyish brown surface soil of silt loam, a subsoil of red or of mottled red and brown silty clay loam or clay; and a deep substratum of red, brown, or vari-coloured clay or silty clay loam that in many places shows the foliated pattern of the weathered rocks.

Typifying pedon: Representative profile of Arakaka silt loam.

A1 — 0 - 5" — Reddish yellow (7.5YR.6/8) silt loam, moderate, medium and coarse, granular and subangular blocky structure; loose and friable; non plastic, and non sticky; fine roots are common; medium roots are few; quartz fragments 2 - 10 mm are common; very strongly acid; gradual and smooth boundary.

A2 — 5 - 7" — Strong brown (7.5YR 5/8) silt loam; moderate, medium, granular structure; loose and friable; non sticky, non plastic, quartz fragments 2 - 6 mm are few; fine roots are common; very strongly acid; abrupt, smooth boundary.

B1 — 7 - 11" — Yellowish red (5YR 5/8) silty clay loam; strong, medium to coarse subangular blocky structure; firm; slightly plastic and slightly sticky; fine roots are common; quartz fragments 2 - 10 mm are few to many; (quartz fragments are in veins), medium roots are few; fine pores are common; strongly acid; clear, smooth boundary.

B2 — 11 - 21" — Red (2.5YR 5/8) clay mottled with few, fine and prominent brownish yellow mottles (10YR 6/8); strong, coarse, subangular blocky structure; firm; plastic and sticky; quartz fragments appear to be in veins and run from one horizon to another; (quartz fragments are 2 - 10 mm); few fine roots; strongly acid, gradual smooth boundary.

B3 — 21 - 30" — Red (2.5YR 4/8) silty clay with common, fine and prominent brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) mottles; moderate, coarse subangular blocky structure; firm; plastic and sticky; few fine roots, many fine 1 - 2 mm pores; strongly acid; gradual smooth boundary.

C — 30 - 42" — Red (2.5YR 5/6) silty clay with a greasy and kaolinite feel, massive structure but friable when crushed; slightly sticky and slightly plastic, streaks of white (2.5Y 8/1) and pale yellow (2.5Y 8/4) are common weathered rocks with colours of yellowish brown (10YR 5/4), white (10YR 8/1), pale yellow (2.5Y 8/4) are common, few fine roots, strongly acid.

Type Location: The representative profile was described and sampled along the road leading to pump house, near the upper dam along the edge of the proposed farm near Matthews Ridge.

Range in Characteristics: The subsoil is generally silty clay loam or clay, mottled red and brownish yellow or brown. Proportions of red and brown colour vary greatly. The substratum in most places is weathered foliated rocks, apparently schist or other rocks that have weathered into clay or silty clay loam, soft but with foliation of the rock still evident. Gravel, largely fragments or quartz, is present on or in the soil, in some places as a definite stone line more or less parallel to the present surface. In some places the surface soil is too gravelly to permit boring with an auger; in others, the stone line is beneath the surface. Stone lines that apparently resulted from weathering of quartz veins can also be seen in the railway outs and other excavations; they are not parallel to the present surface or to the foliation of the rocks. Fine and medium gravel, rounded, presumably iron or manganese compounds, are common on the surface and in the profile at some places.

Competing series and their differentiae: Closely competing series have not yet been fully defined. The soil contains less fine gravel and coarse sand and much more silt, and is much more friable throughout than soils of the Wauna series. The soil is lighter coloured, much less stony or gravelly, and has more clearly differentiated horizons than the Hosororo soils.

Setting: Arakaka soils are in rolling uplands underlain chiefly by fine-grained, foliated rocks. Presence of stone lines, and occurrence of these soils on rocks that contain more coarse or medium sand, and on rocks that ordinarily weather to form red clay, all suggest that in many places the soil profile or part of it has been developed in colluvial deposits. Slopes range from level to more than 30 percent.

Principal Associated soils: The reddish brown or strong brown, generally gravelly or stony Hosororo soils are on hills that are underlain by dark-coloured rocks. A soil with somewhat poor natural drainage (indicated by subsoil of mottled red and light grey) was seen on some benches. A dark coloured soil in recent alluvium was described by Glenn Robinson and others in 1961. Other associated soils no doubt will be discovered when soil surveys are made.

Drainage and Permeability: Well drained. Permeability estimated to be moderate. Runoff is rapid and erosion is severe, if moderate or steep slopes are left unprotected.

Vegetation and use: Native vegetation is tropical rain forest. Trees pointed out were called Yari-yari, baramani, aramata, various bali, and other hardwoods.

Few areas have been cleared for cultivation. Some bananas or plantains were seen. Corn is growing well in one place along the railway. Patches of kudzu and of a Desmodium were observed, mostly on the shaped soil near the railway tracks, growing vigorously. Capability Subclass of A, B, and C slopes, IIIe.

Distribution and Extent: Not known. The geological map suggests possibly 1200 square miles of Arakaka and associated soils in the Northwest District, in scattered areas, mostly within a belt about 30 miles from north to south, that stretches from the upper Waini River about 100 miles westward to the Venezuela border and probably beyond.

Series established: Suggested, 1965 by J. G. Steele in an exploratory study of soils along the railway from Port Kaituma to Matthews Ridge. Established February, 1966 by H. N. Ramdin in Soil Survey of proposed farm at Matthews Ridge.

Sources: Observations by J. G. Steele, June 1965 and by J. G. Steele and H. N. Ramdin, February, 1966.

Arima Series 750

Soils of the Arima series are classified as members of a fine loamy family of Oxic Ochraquults; and as Low Humic Gley soils, very poorly drained. The soil typically has a surface layer of very dark grey or black sandy loam or sandy clay loam; and a subsoil grey to light yellowish brown, moderately firm sandy clay or clay.

Typifying pedon: Representative profile of Arima sandy clay loam.

A1 -- 0 - 7" -- Greyish brown (10YR 5/2) sandy clay loam; moderate, medium, granular structure; friable, slightly sticky, slightly plastic; many fine roots and worm holes; extremely acid; gradual boundary.

A3 -- 7 - 12" -- Light greyish brown (10YR 6/2) fine, sandy clay loam; weak,medium, granular structure; slightly sticky, slightly plastic; few fine roots; extremely acid; clear wavy boundary.

B2 -- 12 - 23" -- Grey (5Y 6/2) sandy clay to clay; common, fine, distinct yellowish brown and strong brown mottles; weak, fine, blocky structure; sticky and plastic; some penetration of A3 material; few fine worm holes and root channels; some remains of root cortex; extremely acid; clear wavy boundary.

B3 -- 23 - 31" -- Light grey (5Y 7/1) clay to sandy clay; common fine distinct yellowish brown and strong brown mottles; weak, fine subangular blocky structure; sticky and plastic; extremely acid; gradual wavy boundary.

Alb -- 31 - 40"+ -- Grey (N/5) clay to sandy clay with small pockets of grey (N4); weak, fine, angular blocky structure; soft; sticky and plastic; extremely acid.

Type location: The representative profile was described and sampled about 2½ miles southeast of Ituni, between the Demerara and the Berbice Rivers, in northeastern British Guiana.

Range in Characteristics: Colour of the surface soil ranges from greyish brown to black; texture from sandy loam to sandy clay. Colour of the subsoil ranges from grey to very pale brown. Mottling ranges from few to many mottles of fine to medium size, brownish yellow to strong brown with some red. Texture of the subsoil is sandy clay or clay. Differentiation of the B horizon ranges from slight to moderate. Most profiles do not have the buried Alb horizon that is in the profile described.

Competing series and their differentiae: Arima soils contain more clay than Mibirikuru (740) or Wiruni (742) soils, and have mottled subsoil that shows they are more poorly drained than Ebini soils (820).

Setting: Arima soils are along small streams and in depressions or potholes in areas of relatively fine textured sediments of the Berbice formation. In many places the microrelief is very uneven, with many steep-sided humps about 1 foot high and 1 foot wide.

Principal Associated soils: Ebini soils (820) are on adjacent well-drained uplands. Aroaima soils are in similar locations to Arima soils and have similar texture, but have a thicker dark-coloured surface layer. Mibirikuru (740) soils and Wiruni (742) soils are lighter textured soils in similar locations. Mixed alluvial land, peat, or muck are in some of the adjacent lowlands.

Drainage and Permeability: Very poorly drained, and probably very slowly permeable. The soils are flooded during part of each year, and artificial drainage would be very difficult because of the lack of outlets.

Vegetation and use: Native vegetation is forest or savannah. The soils are extremely acid and extremely low in natural fertility. Several crops and pasture plants can be produced during dry seasons, but lime and fertiliser are necessary. Drainage would be required for long-season crops. Capability Subclass IIIw.

Distribution and Extent: Arima soils occupy about 2,300 acres in the Ebini-Ituni-Kwakwani soil survey area. It is likely that a small but significant acreage occurs throughout the gently sloping sandy plains.

Series established: Soil Survey of Ebini-Ituni-Kwakwani Area, 1963.

Remarks: Classified by G. H. Robinson in Typic Ochraquults, but have low cation exchange capacity and low base saturation.

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary report, 1964. Compiled in this form by J. G. Steele, January, 1966.

Aroaima Series 752

Soils of the Aroaima series are classified as members of a fine loamy family of Typic Umbraquults; and as Humic Gley soils, very poorly drained. Aroaima soils typically have a thick surface soil of black sandy loam or sandy clay loam, and a subsoil of light grey to light yellowish brown sandy clay.

Typifying pedon: Representative profile of Aroaima sandy loam.

A11 — 0 - 13" — Black (10YR 2/1) sandy clay loam; moderate, fine, granular structure; friable; slightly plastic, non sticky; many fine roots and an occasional medium root; extremely acid; gradual, wavy boundary.

A12 — 13 - 24" — Dark grey (10YR 4/1) sandy clay; weak fine granular structure; friable, slightly plastic, non sticky; common fine roots; extremely acid; clear smooth boundary.

C1 — 24 - 36" — White (10YR 7/2) sandy clay: few, medium, faint brownish yellow mottles; weak fine granular structure; friable; slightly plastic; non sticky; occasional roots; extremely acid; fine, medium, faint brownish yellow mottles; gritty, somewhat compact, non plastic; extremely acid.

Type location: The representative profile was described and sampled about 7½ miles west of the Berbice River and 5 miles south of the Wiruni Creek, in Northeastern British Guiana.

Range in Characteristics: Thickness of the dark coloured surface layer ranges from 10 to 20 inches. Colour of the surface layer is black or very dark grey; its texture ranges from sandy loam to sandy clay loam. Colour of the subsoil ranges from white to greyish brown, and texture from sandy clay to clay. Degree of profile development, as indicated by structure, is weak or moderate.

Competing series and their differentiae: Aroaima soils have a thicker dark coloured A1 horizon than Arima soils (750); 10 inches or more in thickness. Aroaima soils and Arima soils contain more clay than the Mibirikuru (740) or the Wiruni (742) soils. They have greyer subsoil and are more poorly drained than Ebini (820) soils.

Setting: Aroaima soils are along small streams and in depressions or potholes, in relatively fine textured sediments of the Berbice formation. In many places the microrelief is very uneven, and on the surface are steep-sided humps about 1 foot high and 1 foot wide.

Principal Associated soils: Ebini soils (820) are in adjacent well-drained locations. Arima soils (750) are in similar locations but have a dark-coloured surface layer less than 10 inches thick. Mibirikuru soils (740) and Wiruni soils (742) are in similar locations where the soil material contains somewhat less clay. Mixed alluvial land and peat or muck are in some of the nearby lowlands.

Drainage and permeability: Aroaima soils are very poorly drained, and probably are slowly or very slowly permeable. They are flooded during part of each year.

Vegetation and Use: Native vegetation is forest or savannah. Aroaima soils are extremely acid and extremely low in plant nutrients. Drainage is very difficult because of the lack of outlets. With lime and fertilizer, annual crops could be grown during dry seasons, and some pasture could be obtained. Drainage would be needed for long-season crops. Capability Subclass IIIw.

Distribution and extent: Aroaima soils occupy about 2,200 acres in the area covered by the Ebini-Ituni-Kwakwani soil survey. Further extent throughout the gently sloping sandy plains probably is small but significant.

Series Established: Soil Survey, Ebini-Ituni-Kwakwani Area, 1963.

Remarks: Since cation exchange capacity and base saturation are low, possibly these soils should be classified in an Oxic subgroup.

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary report 1964. Compiled in this form by J. G. Steele, January, 1966.

Baiabo Series 220

Baiabo peat was described in the Soil Survey of the Mahaica-Mahaicony-Abara Area as a soil that resembles Anira peat, but is underlain at 36 - 48 inches by a layer of silt several inches thick that has "catch-cow" properties; that is, the silt flows when wet.

Baiabo peat was mapped on only 780 acres. Since it is distinctly a minor soil, it can be classified (if found in future soil surveys) as a silty substratum phase or variant of Anira peat, and the name Baiabo can be dropped.

Bath series 34a

Soils of the Bath series are classified as members of a clayey moderately permeable family of Typic Ochraquults; and as poorly drained Low Humic Gley soils grading toward Red-Yellow Podzolic soils. They have a thin grey or greyish brown surface soil, a moderately friable clay subsoil that is grey mottled with red and some yellowish brown, and a substratum of silt loam that contains lenses of silt.

Typifying pedon: Representative profile of Bath silty clay.

A1 — 0 - 6" — Light brownish grey (10YR 6/2) silty clay loam to silt loam with few, medium, distinct brownish yellow mottles; medium, granular structure; friable; slightly plastic and sticky; common, fine, and few, medium roots; very strongly acid; clear, smooth boundary.

B21g — 6 - 20" — Grey (5Y 5/1) clay with many, medium, prominent brownish yellow and red mottles; medium subangular blocky structure; firm; slightly plastic and sticky; few fine roots; very strongly acid; gradual smooth boundary.

B22g — 20 - 35" — Grey (5Y 5/1 - 6/1) clay with common, medium, prominent red and few yellowish brown mottles; moderate, medium subangular blocky structure; firm; plastic and sticky; evidence of clay flows; occasional fine roots; very strongly acid; gradual wavy boundary.

B3g — 35 - 43" — Grey (5Y 5/1) silty clay with common, medium, prominent yellowish brown mottles; massive structure; firm; slightly plastic and sticky; few silt lenses; medium acid; gradual; smooth boundary.

Cg — 43 - 60" — Grey (5Y 6/1) silt loam with common, medium, prominent strong brown mottles; structureless; friable; slightly plastic and slightly sticky; some lenses of silt up to 3 inches in width; mildly alkaline.

Type location: The representative profile was described and sampled about three-fourths mile east of the Berbice River and 8 miles southwest of Mara in Berbice County.

Range in Characteristics: Colour of the A horizon ranges from very dark grey to dark greyish brown; that of the subsoil from greenish grey to mottled grey and yellowish brown. Texture of the surface soil in most places is clay or silty clay, but ranges to silt loam. Texture of the substratum ranges from clay to silt loam. Soft concretionary material and thin lenses of silt are in the C horizon and the substratum in many places. Reaction of the C horizon ranges from pH 5.0 to 7.0.

Competing Series and their differentiae: Bath soils resemble Vryberg soils (34) but their subsoil is more permeable and less acid, and their substratum is less acid. They are similar to the Everton soils (31a) but are slightly better drained and have red mottling in the B horizon. They are less permeable, more acid, and have much more brown and red mottling than the De Velde soils (1c). The surface soil contains less organic matter than that of the Brandwagt soils (32a).

Setting: Bath soils developed in fine textured alluvium of the old natural levees along streams. They are nearly level and are slightly higher than the wetter soils in marine sediments.

Principal Associated soils: Vryberg (4), Canje (31), and Everton (31a) soils are in similar locations on the natural levees of alluvial deposits; Kerkenama (32) and Brandwagt (32a) soils are in depressions in the same kind of material.

Drainage and Permeability: Poorly drained and moderately permeable; less permeable than De Velde soils (1) and more permeable than Vryberg soils (34).

Vegetation and Use: Native vegetation is tropical rain forest of kokerite palm, manicole palm, mora, trysil, carbwood, and other trees and herbacenous plants. The soils are not well suited for coconuts or for some root crops, but they are well or moderately well suited for most other common crops. The soils are acid in the surface layer and are moderately low in calcium, potassium, and phosphorus. Lime and complete fertilizers are needed to maintain good yields. Capability subclass If.

Distribution and extent: Bath soils occupy about 50 square miles in the area covered by semi-detailed surveys. Their further extent probably is less. The main areas are near the Canje River.

Series Established: Soil Survey of Mahaica-Mahaicony-Abary Area, 1962.

Remarks: None

Source: Soil Survey of the Mahaica-Mahaicony-Abary Area and the Canje Area, preliminary releases, 1964. Compiled in this form by J. G. Steele, November, 1965.

Benoni Series

Soils of the Benoni series are members of a clayey family of Umbric Plinthaquults. They are also classified as Ground-Water Laterite soils, poorly drained. The surface soil is black mucky clay that grades to grey clay or sandy clay that contains coarse, red mottles or concretions.

Typifying Pedon: Profile of Benoni clay.

0 - 5"	—	(10YR 3/1) black mucky clay.
5 - 10"	--	(10YR 3/1) very dark slightly humic clay.
10 - 23"	--	(10YR 5/1) grey clay; a weakly developed, coarse, prismatic structure riddled with root channels, friable; a few fine soft brick-red concretions.
23 - 40"	--	(10YR 7/1) light grey sandy clay; structureless; very common, coarse, brittle to hard, brick-red concretions, many medium to coarse, soft orange concretions.

Type Location: Marakanata Basin in the Northern Rupununi Savannah, Southwestern British Guiana.

Range in Characteristics: Not given in description available in 1965.

Competing Series and their Differentiae: Not available, 1965. If Suggett's Low Humic Gley soil of the wide alluvial terraces (in his mapping unit Az) is recognized as a different series, the differentiae will need to be established.

Setting: "Cachoeira Series occurs in association with Benoni Series and together they cover the main mass of the Northern Savannahs. The soils are developed over the old basin sediments with gentle swells and large tortuous ponds typifying the landscape. Flooding covers most of the area during the wet season and mounds reminiscent of "hog wallow" cover extensive areas of low-lying land. These heaps of earth, which become very hard in the dry season, are about two feet in diameter and a foot high. Flooding causes repeated redistribution and resorting of the basin sediments and of hill wash material. Indeed, mapping of the association as two separate series, i.e. Cachoeira and Benoni Series was a deliberate attempt at portraying this feature of the environment. The higher lying Cachoeira Series is the better drained sandier series in the association, with Benoni Series as the more clayey, longer flooded and poorer drained member".

Principal Associated Soil: Cachoeira soils on low sandy swells; Ireng soils and Rupununi soils along the respective rivers.

Drainage and Permeability: Poorly drained, or possibly very poorly drained; very slowly permeable. Flooded for several months each year. Water table in December was at 26 inches.

Vegetation and Use: Vegetation on the site described was small swamp grass. Because of flooding, grazing is about the only practicable use.

Distribution and Extent: Benoni soils occupy about 112 square miles in the area covered by soil surveys. The extent of similar soils, probably of the Low Humic Gley great group, is likely to be several times larger.

Series established: Soil survey of the Rupununi Savannahs (continued) published 1959.

Remarks: The description by Suggett and Braun of their mapping unit Gg suggested that the dominant soils of the Marakanata Basin probably belong to the Low Humic Gley great group.

Source: Compiled from soil and Land Use Surveys No. 6, British Guiana. Regional Research Centre at I.C.T.A., Trinidad, W.I., June 1959.

Black Bush Series 3

Soils of the Black Bush series are members of a clayey, acid over neutral family of Aquic Haplorthents. They are also classified as Low Humic Gley soils, very poorly drained. The surface soil is thick, black or very dark grey clay. The subsoil is greenish grey, firm clay, mottled with yellowish red and yellowish brown.

Typifying pedon: Profile of Black Bush clay, 1 mile west of Berbice River, near Sisters.

AO — 2 - 0" — Black (10YR 2/1) well decomposed organic material consisting primarily of fine roots; twigs and leaves mixed with some mineral material.

A1 — 0 - 10" — Black (10YR 2/1) clay; high in organic matter content; medium, coarse, angular blocky structure; friable; moderately plastic and moderately sticky; fine and medium roots are numerous; extremely acid; clear, smooth boundary.

C1g — 10 - 17" — Grey (N6) clay mottled with yellowish red and yellowish brown; mottles are common, fine and prominent; massive to weak coarse angular blocky structure; hard when dry; firm when moist; plastic and non sticky when wet; few roots; very strongly acid; gradual boundary.

C2g — 17 - 34" — Grey (5Y 6/1) clay mottled with yellowish brown; mottles are many, medium and prominent; massive structure; plastic and non sticky; very hard when dry; few roots; medium size firm concretions are common, some cracks extending from horizon above are filled with darker material, very strongly acid, gradual boundary.

C3g — 34 - 46"+ — Bluish grey (5BG 6/1) clay mottled with yellowish brown; mottles are common, coarse and medium and distinct; massive to weak coarse angular blocky structure; a few concretions; occasional thin strata of very fine sand; plastic, slightly sticky; neutral reaction.

Type location: West of Berbice River, about 9 miles southwest of Rosignol in British Guiana.

Range in Characteristics: If uncultivated, the A1 horizon ranges from very dark grey to black. Thickness of the organic layer on the surface ranges from 1 to 4 inches. Texture of the surface layer is clay or silty clay. Texture of the subsoil ranges from silty clay to clay; consistence is firm or very firm. Some red mottling may be present in the C horizon. Depth to the soil of neutral reaction ranges from 24 to 36 inches. The substratum may be marine clay or river alluvium; the marine clay contains thin strata of silt and streaks of red mottling that are in old root channels.

Competing series and their differentiae: Black Bush soils are more friable, less acid in the subsoil, less firm, and less mottled than Brandwagt soils (32a) and the Kerkenama soils (32). They are more poorly drained and darker coloured than the De Velde soils (1) and have darker coloured surface soil and higher organic matter content than Plegt Anker soils (5).

Setting: Black Bush soils developed in alluvium of fine or moderately fine texture. The alluvium contains some marine material. They are along streams in coastal areas, that carried some brackish water while the alluvium was deposited.

Principal Associated soils: De Velde (1), Moleson (8), and Plegt Anker (5) soils were formed in similar materials but in slightly better drained positions. The Canje (31) and Everton (31a) soils are in higher positions and are more firm, acid, and mottled.

Drainage and Permeability: Very poorly drained; probably slowly or moderately permeable. Surface runoff is slow.

Vegetation and Use: Native vegetation is water-tolerant forest. The soil is well suited for rice and sugar cane, and moderately suited for orchard crops, bananas, and ground provisions. Good drainage is essential. The soil is relatively high in exchangeable calcium and potassium, but low in phosphorus. In a few places the content of soluble salts is high, probably as a result of flooding during the spring tides. The soil responds to good management. Capability subclass If.

Distribution and Extent: Only 620 acres were mapped in the Soil Survey of the Mahaica-Mahaicony-Abary Area.

Series established: Soil Survey of the Mahaica-Mahaicony-Abary Area, 1963.

Remarks: Because of small extent and because characteristics grade toward those of De Velde soils, it is suggested that these soils could be named as a dark-coloured phase of De Velde soils.

Source: Described in the report of the soil survey, Mahaica-Mahaicony-Abary Area, by Clyde C. Applewhite, 1964. Arranged in this form by J. G. Steele, November, 1965.

Brandwagt Series 32a.

Soils of the Brandwagt series are classified as members of a clayey, moderately permeable family of Typic Umbraquults; also as Low Humic Gley soils, very poorly drained. They have a thick, very dark grey surface soil and a subsoil of clay that is grey mottled with yellowish brown to yellowish red. The substratum is greenish grey clay that in most places is neutral or slightly alkaline.

Typifying pedon: Representative profile of Brandwagt clay.

A1 — 0 - 12" — Black (10YR 2/1) clay; fine to coarse angular blocky structure; very firm; common, medium to coarse woody roots; very strongly acid; gradual boundary.

B2g — 12 - 25" — Mottled yellowish brown (10YR 5/6) and grey (5Y 5/1) clay; weak medium angular blocky structure; firm; non sticky; plastic; very few roots; very strongly acid; abrupt boundary.

B3g — 25 - 41" — Greenish grey (5GY 5/1) clay mottled with yellowish brown (10YR 5/6); mottles are many, medium and prominent; massive structure; non sticky; plastic; clay skins occur along the horizontal faces of some peds; occasional roots; neutral; abrupt boundary.

Cg — 41 - 60"+ — Mottled light olive brown (2.5Y 5/4), grey (5Y 6/1) and very dark grey (10YR 3/1) fine sand; loose; mildly alkaline.

Type location: The representative profile was described and sampled at Sisters, Berbice River, 2¼ miles southwest of Rosignol, in Berbice County.

Range in Characteristics: Colour of the surface soil ranges from black or very dark grey to mottled grey and yellowish brown. Mottling in the B and C horizons ranges from yellow to dark red. Reaction of the substratum ranges from pH 5.0 to 9.0. In some places there is a thin layer of peat on the surface. A soft substratum phase was recognized in which the substratum is soft, greenish grey, highly saline clay that in some places contains toxic sulphates.

Competing series and their differentiae: Brandwagt soils are more poorly drained and have darker coloured surface soil than Canje (31) or Vryberg (34) soils. They are similar to Kerkenama soils (32), but the lower subsoil and the substratum are less acid and the subsoil appears to be more permeable. They have a B horizon that is firmer and has stronger structure than the subsoil of Black Bush soils (3).

Setting: Brandwagt soils are in low places with old natural levees of alluvial sediments, along streams of the coastal area.

Principal Associated soils: Brandwagt soils in most places adjoin or are surrounded by areas of Canje (31) Everton (31a) Vryberg (34) or Bath (34a) soils. In some places they adjoin areas of De Velde soils (1c or 1s) or of Corentyne (11) or other soils of the swampy marine sediments.

Drainage and Permeability: Very poorly drained; probably slowly or moderately permeable but slightly more permeable than Kerkenama soils.

Vegetation and Use: Native vegetation is wet savannah or water tolerant forest. The surface soil is strongly acid but the lower subsoil in most places is neutral and the native fertility is higher than that of the similar Kerkenama soils. The upper horizons are moderately low in calcium and potassium, and low in phosphorus. The soils are well or moderately well suited for most crops, including rice, sugar cane, vegetables, and pasture. Lime and fertilizer are needed to maintain good yields. The soft substratum phase contains more salt and is difficult to drain, but after leaching is moderately suited for most crops. Land Capability subclass If; the soft substratum phase, before salts are leached, is in Capability subclass IIs.

Distribution and Extent: About 46 square miles were mapped on the semi-detailed soil surveys before 1965. Further extent probably is not great.

Series Established: Soil Survey, Mahaica-Mahaicony-Abary Area, 1962.

Remarks: None

Source: Soil Surveys of Canje Area and Mahaica-Mahaicony-Abary Area, preliminary releases, 1964. Compiled in this form by J. G. Steele, November, 1965.

Brickery Series, 36

Soils of the Brickery Series are classified as members of a family of Aquic Haplorthents that are fine silty or clayey, moderately deep, over soft, sulphate-containing clay. In the classification of 1938 they are Low Humic Gley soils, poorly drained. The soils have a dark grey surface layer of clay or silty clay, and may have as much as 12 inches of peat on the surface of the mineral soil. The subsoil is greenish grey clay or silty clay loam, mottled with brown; below a depth of 18 to 36 inches is greenish grey soft clay silty clay or clay that contains pieces of organic matter and in many places contains acid sulphates.

Typifying Pedon: Representative profile of Brickery Clay.

1 — 11 - 0" Very dark grey (10YR 3/1) well decomposed muck; massive structure; slightly sticky and non plastic; many fine roots; extremely acid; gradual, smooth boundary.

2 — 0 - 16" Grey (5Y 6/1) silty clay; mottles of strong brown (7.5YR 5/8) and yellowish brown (10YR 5/4) are many; fine and prominent and occurring mainly along old root channels; massive structure; slightly sticky and plastic; few, fine, black organic specks; very strongly acid; gradual, smooth boundary.

3 — 16 - 30" Greenish grey (5GY 6/1) silty clay loam with few, medium and fine, prominent strong brown (7.5YR 5/8) mottles along old root channels; massive structure; slightly plastic and slightly sticky; scattered bits of organic material; extremely acid; gradual, smooth boundary.

4 — 30 - 42"+ Greenish grey (5GY 6/1) silty clay loam; massive structure; slightly plastic and slightly sticky; many pieces of partially decomposed plant residues; slightly alkaline.

Type Location: Along Hauraruni River, between Atkinson Airport and Dora, about 3 miles east of the Demerara River.

Range in Characteristics: Depth to the soft, greenish grey material ranges from 18 to 36 inches. Colour of the surface soil ranges from grey to very dark grey. Thickness of peat over the mineral soil ranges from 1 to 12 inches. Mottles in the subsoil are brown, strong brown, or reddish yellow. Reaction in the lower substratum ranges from pH 6.5 to 8.0 when wet, but is likely to be strongly acid after drying.

Competing series and their differentiae: The depth to soft, greenish grey clay or silty clay that contains organic matter and acid sulphates is 18 to 36 inches; greater than in Marinero soils and less than in Tuschen soils. Mottling, presumably caused by segregation of iron compounds, is more prominent in the subsoil than in the subsoil of De Velde soils (1s and 1c).

Setting: Brickery soils are usually in slightly lower positions than Tuschen soils, on alluvial deposits along streams and near the margins of swamps in which are Anira peat (20) or Mara soils (21 or 22).

Principal Associated Soils: Tuschen Soils (39), Everton soils (31a) and in some places De Velde soils (1c or 1s) are on higher parts of the alluvial deposits sometimes called natural levees. Marinero soils (101), Mara soils (21 or 22) and Anira peat (20) are in lower places, in or near the swamps.

Drainage and Permeability: Poorly drained, slow permeability.

Vegetation and Use: Native vegetation is water tolerant forest, often with a considerable proportion of manicole palm. The soils are strongly acid and low in plant nutrients, especially calcium, potassium, and phosphorus. The substratum below a depth of 18 to 36 inches contains toxic sulphates and is likely to turn extremely acid if it is drained and aerated. Drainage is difficult because of the low postion; but strict control of the water table is needed, if crops are grown, to prevent toxic sulphates from rising into the root zone. With expert management, rice, sugar cane, bananas, plantains, ground provisions and probably other crops can be grown.

Distribution and Extent: Near margins of peat swamps in the coastal plain. Total extent is small, probably not more than 20 to 50 square miles.

Series Established: Soil Survey, Hauraruni-Marakai Area, 1964.

Remarks: None.

Source: Soil Survey, Hauraruni-Marakai Area, by H. N. Ramdin, 1964. Compiled in this form by J. G. Steele, March, 1966.

Burru Series

Soils of the Burru series are classified as Typic Ochraqualfs, members of a clayey family and as Low Humic Gley soils (poorly drained). They are in depressions and on slope bottoms in areas of Lethem soils and consist of dark grey sandy clay, greyish brown sandy clay, and pale olive clay. The lower subsoil is mottled.

Typical Profile of Burru Clay:

0 - 5"	(10YR 4/1); dark grey sandy clay; weak very fine crumb structure.
5 - 13"	(10YR 5/2); greyish brown slightly sandy clay; structureless.
13 - 36"	(5Y 6/3); pale olive clay; structureless.
36 - 71"	(5Y 7/2); light grey heavy clay; structureless; common red mottling.

Type Location: Near Letham in the Rupununi Savannah, Southwestern British Guiana.

Range in Characteristics: Not available, 1965.

Competing Series and their Differentiae: Burru soils are less sandy and not so poorly drained as Makushi soils.

Setting: Burru soils are on bottom slopes next to areas of Lethem soils, members of the mapping unit named the Lethem - Burru Association. Lethem soils in the association occupy slopes between the lateritic hills. Burru soils are liable to seasonal flooding and dry out quickly in the dry season.

Principal Associated Soils: Lethem soils on higher slopes, St. Ignatius soils on ironstone hills.

Drainage and Permeability: Apparently poorly drained and slowly permeable.

Vegetation and Use: Vegetation is savannah grasses and scattered stunted shrubs. Used for grazing.

Distribution and Extent: The Lethem - Burru Association occupies 66 square miles, near Lethem, in the areas covered by soil surveys. Burru soils make up about 35 percent of the association, or about 23 square miles.

Series Established: Soil Survey of Rupununi Savannahs (No. 2) published March,1958.

Remarks: Classification has been estimated from the published description. Ranges of characteristics need to be defined more precisely.

Source: Soil and Land Use Survey No. 2, The Rupununi Savannahs, Regional Research Centre, I.C.T.A., Trinidad, W.I., March, 1958.

Buxton Series 45

Soils of the Buxton series are classified as members of a clayey family of Typic Ochraqualfs; also as Low Humic Gley soils, poorly drained. They have thin, very dark grey surface soil and brownish yellow clay subsoil, over a substratum of greenish grey soft clay. The surface soil is very strongly acid but the subsoil below about 16 inches is neutral or mildly alkaline.

Typifying pedon: Representative profile of Buxton clay.

A1 -- 0 - 6" -- Very dark grey (10YR 3/1) clay mottled with yellowish red; mottles are common, fine and distinct, and occurs mainly along root channels; medium to coarse subangular blocky structure; firm; slightly sticky, slightly plastic; numerous fine and few medium roots; very strongly acid; abrupt, smooth boundary.

B22 -- 6 - 16"-- Brownish yellow (10YR 6/8) clay mottled with greenish grey; mottles are common, medium and prominent; few pockets of very dark grey (10YR 3/1) material sloughed in through cracks from the topsoil; fine, and medium angular blocky structure; firm, sticky, plastic; fine roots are common; clay skins occur on vertical faces of peds; medium acid; gradual, wavy boundary.

B23g -- 16 - 40"-- Greenish grey (5GY 6/1) clay mottled with brownish yellow; mottles are common, medium and prominent; massive structure; firm, sticky and plastic; thin clay films are evident; fine roots are common, neutral; gradual wavy boundary.

C1g -- 40 - 50"-- Greenish grey (5GY 6/1) clay mottled with strong brown and yellowish brown; mottles are common, medium and prominent; massive; sticky, plastic; few fine roots; some incipient soft concretions; thin lenses of silt loam material are present; mildly alkaline; gradual, wavy boundary.

C2g -- 50"+ -- Greenish grey (5BG 6/1) silt loam, mottled with strong brown; mottles are common, medium and prominent; massive; slightly sticky, slightly plastic; soft and hard concretions present; pockets of clay; mildly alkaline.

Type location: The representative profile was described and sampled one-half mile north of High Park Dam and one-half mile east of the Mahaicony River in Northeastern British Guiana.

Range in Characteristics: Colour of the surface soil is black or very dark grey; texture is clay or silty clay. Some soft concretions and some thin lenses of silt are present in the substratum.

Competing series and their differentiae: Brownish yellow subsoil distinguishes Buxton soils from Onverwagt soils (41). The surface soil is not so dark coloured as that of the Lichfield soils (42).

Drainage and Permeability: Poorly drained; probably slowly permeable, but easy to drain.

Vegetation and Use: Native vegetation is wet savannah and water-tolerant trees. The surface soil is very strongly acid and in most places it is low in phosphorus and potassium. The soils are easy to drain and till; when drained they are moderately well suited for most crops. Lime and complete fertilizer are necessary to maintain good yields. Capability Subclass Im.

Distribution and Extent: About 22 square miles were mapped in the Mahaica-Mahaicony-Abary soil survey. Several square miles probably are present in parts of the Coastal Plain not yet covered by soil surveys.

Series Established: Mahaica-Mahaicony-Abary Area, 1962.

Remarks: Shells are present at a few places, especially in some places near the sandy ridges. Soils that contain shells are less acid than the one described.

Source: Taken from soil survey of the Mahaica-Mahaicony-Abary Area, preliminary release, February, 1964. Arranged in this form by J. G. Steele, November, 1965.

Cachoeira Series

The Cachoeira soils are members of a coarse loamy over clay family of Ochric Plinthaquults. They are also classified as Ground-Water Laterite soils, somewhat poorly drained. They consist of a surface horizon of grey loamy sand and a subsoil of light grey sandy loam, underlain by light grey sandy clay loam or sandy clay that contains many coarse, brittle, brick-red concretions.

Typifying Pedon: Typical profile of Cachoeira loamy sand.

0 - 12"	(10YR 5/1) grey loamy sand; structureless, loose; common roots.
12 - 34"	(10YR 7/2) light grey sandy loam, structureless, compacted; many coarse, faint, diffuse, orange mottles; some orange mottling along root channels.
34 - 57"	(10YR 7/2) light grey sandy clay loam to sandy clay; structureless; many coarse, brittle, brick-red concretions. Many coarse, faint, diffuse, orange mottles. (This horizon when completely dry becomes white and very hard).

Type Location: Northern savannahs between the Ireng and the Rupununi Rivers, Southwestern British Guiana.

Range in Characteristics: Not available in 1965. Authors of the soil survey report stated that all gradations between the Cachoeira profile and the Benoni profile occur, but did not name the range allowable in each series.

Competing Series and their Differentiae: Competing series were not described. Limits of this series and of the Benoni series need to be stated in writing.

Setting: "Cachoeira Series occurs in association with Benoni series and together they cover the main mass of the Northern Savannahs. The soils are developed over the old basin sediments with gentle swells and large tortuous ponds typifying the landscape. Flooding covers most of the area during the wet season and mounds reminiscent of "hog wallow" cover extensive areas of low-lying land. These heaps of earth, which become very hard in the dry season, are about two feet in diameter and a foot high. Flooding causes repeated redistribution and resorting of the basin sediments and of hill wash material. Indeed, mapping of the association as two separate series, i.e. Cachoeira and Benoni series was a deliberate attempt at portraying this feature of the environment. The higher lying Cachoeira series is the better drained sandier series in the association, with Benoni series as the more clayey, longer flooded and poorer drained member".

Principal Associated Soils: Benoni soils in the basin; Tirke soils on the adjacent lower mountain slopes; Ireng soils and Rupununi soils along the respective rivers.

Drainage and Permeability: Probably somewhat poorly drained and slowly permeable. Flooding covers most of the area during the wet season. The sandy soil dries out very rapidly.

Vegetation and Use: Savannah grasses and shrubs. The site described carried Trachypogon plumosus and Byrsonima crassifolia. Grazing during the dry season is about the only practicable use.

Canje Series 31

The Canje Series consists of soils classified as Typic Ochraquults, member of a clayey slowly permeable family (poorly drained, Low Humic Gley). They have very dark grey clay surface soil over mottled grey, yellowish brown, and strong brown clay subsoil.

Typical Profile of Canje Clay, in a forested area.

A1	0 - 5"	Very dark grey (10YR 3/1) clay; medium, granular structure; plastic and slightly sticky; high organic content; numerous roots; has a relatively high silt content; extremely acid; gradual, smooth boundary.
A3	5 - 11"	Grey (10YR 5/1) clay with many, medium, distinct yellowish red and yellowish brown mottles, many following old root channels; moderate, fine subangular blocky structure; plastic and sticky; extremely acid; gradual, smooth boundary.
B21g	11 - 22"	Grey (10YR 6/1) clay with many, medium, distinct yellowish brown and strong brown mottles; weak, medium, subangular blocky structure; plastic and sticky; firm; common, fine and medium roots; extremely acid; gradual smooth boundary.
B22g	23 - 34"	Grey (10YR 6/1) clay with many, medium, prominent yellowish brown and strong brown mottles; very firm; plastic and sticky; few fine roots; extremely acid; gradual, smooth boundary.
B3	34 - 48"	Grey (10YR 6/1) clay with common, medium, distinct yellowish brown and red mottles; weak, medium, subangular blocky structure; with thin clay flows; very firm; plastic and sticky; extremely acid; gradual, smooth boundary.
C1g	48 - 60"	Grey (5Y 6/1) clay with common, medium, distinct yellow and brown mottles; massive; very firm, plastic and sticky; extremely acid.

Type Location: 3 miles east of Mara in Berbice County.

Range in Characteristics: Colour of the A horizon ranges from very dark grey to dark greyish brown; texture of the A horizon ranges from clay to silt loam. The usual subsoil colour is grey mottled with yellowish brown to yellowish red or dark reddish brown; red mottles are present in some places. In some places the substratum below 48 inches is soft clay that appears to contain acid sulphates.

Competing Series and their Differentiae: Canje soils lack the prominent red mottles in the subsoil that are characteristic of Vryberg (34) soils. They are more acid in the subsoil and substratum and have more prominent structure than the De Velde (1c) or the Plegt Anker (5) soils; and unlike those soils are not subject to flooding at high spring tides. They have a much more firm B horizon, are more acid, and appear to be less permeable than the De Velde (1c) or the Everton (31a) soils. The A1 horizon is thinner than in the Brandwagt (32a) soils and it contains less organic matter than that of the Kerkenama (32) soils.

Setting: Canje soils are at slight elevations on old natural levees along streams in the coastal area. The fine-textured alluvium in which they developed is believed to have been washed primarily from the Coropina and White Sands formations, with some influence from muddy, brackish waters along the coast. Topography is nearly level with some local variation because of kawfootoes, which are low hummocks probably formed by trampling.

Principal Associated Soils: Mara (21) soils in many places are near but slightly lower. Other associated soils are those of the Vryberg (34) Kerkenama (32) and Everton (31a) series.

Drainage and Permeability: Poorly drained, slow runoff, very slow internal drainage, slow permeability, high shrink-swell ratio.

Vegetation and Use: A large part is in tropical rain forest of kokerite palm, manicole palm and koker and numerous vines and small shrubs.

Cleared areas are used for rice, ground provisions, some sugar cane, and a few other crops (one citrus orchard). Shifting cultivation is common. The natural fertility is very low; the soil is difficult to drain because of very firm subsoil and slow permeability. Moderate responses of most crops can be expected, after drainage, to additions of lime and fertilizers. Capability subclass IIm.

Distribution and Extent: Along streams and on slight elevations in the coastal sections of British Guiana.

Series Established: Mahaica-Mahaicony-Abary Area, 1963.

Remarks: None.

Sources: Based on description by Glenn H. Robinson, Robert Brinkman, and Clyde Applewhite, 1964. Arranged in this form by J. G. Steele, May, 1965.

Charity Series 14.

Charity clay, map symbol 14, was named in the Soil Survey of Tapakuma Extension, by Robert Pariag and Clyde C. Applewhite, September, 1964. The description states that Charity clay (14) is closely related to Corentyne clay (11) but contains more salt. The name Charity can be dropped, and the soil should be designated a saline phase of Corentyne clay.

Cola Series 152.

In the Cola series are soils classified as Ochric Plinthaquults, members of a fine silty, moderately permeable family (somewhat poorly drained, Low Humic Gley). They have a greyish brown to brown surface soil and a lighter coloured subsurface soil a grey clay subsoil mottled with yellowish red and strong brown; and a silty, mottled substratum.

Typical profile of Cola silt loam:

O1 -- 1 - 0" -- Leaves and other vegetative residue.

A1 -- 0 - 10" -- Greyish brown to brown (10YR 5/2) to (5/3) silt loam; medium and fine granular structure; friable; slightly sticky; slightly plastic; many fine and medium roots, occasional large roots; extremely acid; clear, smooth boundary.

A3 -- 10 - 14" -- Light grey to light greyish brown (10YR 6/1 - 6/2) silt loam with common fine, distinct, yellowish brown mottles; strong brown mottles seem to occur mainly along old root channels; medium, granular structure; slightly plastic, non sticky; many fine roots; occasional worm holes; pockets of the topsoil occur within the horizon; extremely acid; gradual smooth boundary.

B1 -- 14 - 21" -- Light grey (10YR 6/1) silty clay loam with many, fine, distinct yellowish brown, strong brown and brownish yellow mottles; strong brown mottles occur mainly along old root channels; medium to fine subangular blocky structure; thin clay skins are present; friable; slightly sticky; slightly plastic; common fine white lenses of silt and pockets of topsoil; extremely acid; gradual, wavy boundary.

B2g -- 21 - 30" -- Grey (5Y 6/1) clay with many, medium, prominent yellowish red, reddish yellow and strong brown mottles; strong brown mottles occur mainly along old root channels; soil breaks into irregular peds; clay skins are quite evident along vertical faces of peds; friable; slightly sticky, plastic;extremely acid; gradual, wavy boundary.

B3g -- 30 - 54" -- Light grey (5Y 7/1) clay with many, medium, prominent yellow, yellowish brown and weak red mottles; soil breaks into irregular peds; firm to friable; slightly sticky; plastic; few old root channels; extremely acid; gradual, smooth boundary.

Cg -- 54 - 60"+-- Light grey (5Y 7/1) silt loam with pockets of clay; many, medium, prominent yellow, yellowish brown and weak red mottles; soil breaks into irregular clods; firm to friable, slightly sticky, plastic; few old root holes; extremely acid.

Type location: 1 mile north of Torani Canal at Torani East Lock, near Canje River, Berbice County.

Range in Characteristics: Colour of the surface soils ranges from light grey to brown; texture is silt loam or silty clay loam. Texture of the deep subsoil and the substratum ranges from silt loam to clay.

Competing series and their differentiae: Cola soils are lower and less well drained, and hence more mottled in the subsurface layer, than Potoco soils (157) and Nassau soils (57). They resemble Helvetia aoils (52) but their native vegetation is forest and they are believed to have a somewhat higher level of natural fertility. They lack the abundant mottling that is present in the lower subsoil and the substratum of Torani soils (153).

Setting: Cola soils developed under peat cover in nearly level or gently sloping locations, in silty sediments of the old terraces known as the Coropina formation. The range of slope is from nearly level to 1 or 2 percent. Many areas lie along drainageways.

Principal associated soils: Associated are the better drained Potoco (157) and Yesi (128) soils, and the red-mottled Torani (153) soils. Some small areas occur as islands surrounded by Anira peat (20) or by Mara soils (21, 22).

Drainage and permeability: Somewhat poorly drained. Surface drainage is slow. Permeability probably is moderate or slow.

Vegetation and use: Native vegetation is tropical rain forest, about the same as that described for the Torani soils. Cola soils were judged by the soil survey group (1963) to be poorly suited for sugar cane or bananas, and moderately suited for vegetables and ground provisions. Probably moderately suited for improved pastures if provided with surface drains. Capability Subclass IIw.

Distribution and Extent: Near the margin of the coastal plain of British Guiana, near the boundary of the sloping sandy soils, between the Demerara River and the Corentyne River.

Series Established: Soil Survey of Canje Area, British Guiana, 1963.

Remarks: Differences between Cola soils and Helvetia soils (52) should be investigated. It may be found that the two are enough alike to be in one series.

Source: Soil Survey Report of Canje Area, by Robert Brinkman, 1964; and Ebini-Ituni-Kwakwani Area, by Robert Brinkman, 1964. Assembled in this form by J. G. Steele, July, 1965.

Corentyne Series, 11.

In the Corentyne series are soils classified as Aquic Haplorthents, members of a clayey, non-acid, soft or moderately firm family (Low Humic Gley, very poorly drained). In undisturbed areas the soil is wet and typically consists of 6 to 12 inches of peat, a thin, dark coloured, strongly acidmineral surface horizon of clay, and a neutral or slightly alkaline greenish grey clay subsoil that is mottled with olive brown.

Typical Profile of Corentyne Clay, Forested:

01	9 - 1"	Dark reddish brown (5YR 3/2) partially decomposed organic material, consisting of mixed vegetative residues becoming somewhat more decomposed with depth. Odour of H_2S on exposure to air.
02	1 - 0"	Black (10YR 2/1) muck mixed with ashes and burnt clay.
A1	0 - 6"	Dark grey (10YR 4/1) clay, massive structure; slightly plastic and sticky; many fine and few medium roots; partially decomposed organic residues scattered throughout the horizon; very strongly acid; abrupt boundary.
B2g	6 - 15"	Light greenish grey (5GY 7/1) clay with few, medium, prominent strong brown mottles; occurring mainly along root channels; massive structure; plastic and sticky; few fine and occasional medium roots; pockets of A1 material scattered throughout the horizon; strongly acid; clear boundary.
C1g	15 - 31"	Greenish grey (5G 6/1) clay with common, medium, prominent light olive brown mottles; massive structure; plastic and sticky; few fine roots; neutral; gradual boundary.
C2g	31 - 41"	Greenish grey (5GY 6/1) clay mottled with common, medium, prominent light olive brown mottles; few soft dark brown concretions; massive structure; plastic and sticky; thin lenses of silty clay loam material ($\frac{1}{4}$" - $\frac{1}{2}$") occur at intervals of 1" - 3" throughout the horizon; neutral; gradual boundary.
C3g	41 - 51"	Greenish grey (5GY 6/1) silty clay loam with few, fine, prominent light olive brown mottles; few soft olive brown concretions;some mottled spots are incipient concretions; massive structure; slightly plastic and slightly sticky; many strata and small pockets of silt loam material scattered throughout the horizon; neutral.

Type Location: Five miles south of Crabwood Creek and one mile west of Corentyne River, in Berbice County, British Guiana.

Range in Characteristics: Thickness of peat over the mineral soil ranges from 0 - 24"; a peaty phase is classified if the thickness of peat is 12 to 24". Colour of the A horizon ranges from dark grey to black, and the thicknessfrom 1 to 7 inches. In some places an A3 horizon is present. The horizon of ash and burned clay is not present everywhere. Drained areas have firmer consistence in the subsoil than the described, and yellowish rather than olive mottling. When the subsoil is exposed to air, its colour changes from greenish grey to light brownish grey. Grey to dark brown balls of clay or silt, and silty concretions are common. Depth to soil neutral in reaction ranges from 12 - 24 inches. Thin strata of silty soil are present in many places in the lower subsoil. Colour values are 1 or 2 units higher when the soil is dry.

Competing Series and their Differentiae: Corentyne soils are slightly firmer than Mara soils (21), do not contain acid sulphates, and have greenish grey rather than generally grey subsoil. They are less mottled and have softer consistence than the Onverwagt soils (41). They lack the amounts of soluble salts that are present in Weldaad (44) and in Fairfield (147) soils. They have softer consistence and less prominent structure in the subsoil than Everton (31a) or Brandwagt (32a) soils. They are more alkaline and contain more olive brown mottling than the Manarabisi soils (211).

Setting: Corentyne soils consist of sediments that were laid down in marine or brackish water. They lie near the coast and also behind areas of slightly higher, more silty soils on the natural levees. They lie in a basin, and if not drained artificially they are covered with water in all but the driest periods.

Principal Associated Soils: Associated with Manarabisi soils (211) and with Whittaker soils (37) in low basins with Mara soils (21), Onverwagt soils (41), and Weldaad soils (44) and with Plegt Anker soils (5), and with Everton soils (31a) and Brandwagt soils (32a) which are on natural levees in slightly higher locations.

Drainage and Permeability: Very poorly drained. The soil is covered with water unless artificially drained. Permeability is moderately slow.

Vegetation and Use: Native vegetation is tropical rain forest of swamps, containing corkwood, white cedar, sandkoker, manicole palm, monkey apple, moco-moco, fine grass, blechnum fern, and mat grass. Burned or cut over areas contain fewer trees. A large part is in forest. Cleared areas are used for rice, sugar cane, ground provisions, bananas and plantains. Natural fertility is fairly high. Crops respond to drainage, and most crops respond to fertilizers. With good management including use of fertilizer, high yields can be maintained. Capability subclass Im.

Distribution and Extent: In the coastal areas of north-eastern British Guiana and probably in Surinam.

Series Established: Canje Area, British Guiana, 1963.

Remarks: A drained phase (11d) and a peaty phase (12) have been recognized in addition to the normal (undrained) mapping unit.

Sources: Described by Glenn H. Robinson, November, 1963. Prepared in this form by J. G. Steele, August, 1965.

Dageraad Series 58

In the Dageraad series are soils classified as Plinthic Normudults, members of a fine silty family (Red-Yellow Podzolic Ground Water Laterite intergrade well drained or moderately well drained). The surface soil is brown or greyish brown silt loam, the subsoil is friable grey silty clay loam mottled with dark red and reddish yellow.

Typical profile of Dageraad silt loam:

A1 — 0 - 4" — Brown (10YR 5/3) silt loam; weak, fine, granular structure; friable; non sticky; slightly plastic; common medium and fine roots; worm holes and worm casts present; extremely acid; gradual, wavy boundary.

A3 — 4 - 8" — Mottled grey (10YR 6/1) and pale brown (10YR 6/3) silt loam; medium granular structure; friable; common, medium and fine roots; common medium worm casts; extremely acid, clear, smooth boundary.

B1 — 8 - 13" — Yellowish brown (10YR 5/8), mottled with yellowish red silt loam; weak, medium, subangular blocky structure; friable; slightly plastic, non sticky when wet; some penetration of A material; common medium and fine roots; extremely acid; gradual, wavy boundary.

B2 — 13 - 18" — Yellowish brown (10YR 5/8) mottled with yellowish red and some red (10YR 4/8) silty clay loam; weak, medium subangular blocky structure; friable; slightly plastic; slightly sticky when wet; few fine and medium worm casts; extremely acid; clear, smooth boundary.

C1 — 18 - 26" — Grey (5Y 6/1) silty clay with many, large and prominent red and dark red and common, medium, prominent yellowish brown mottles; moderately coarse and medium angular blocky structure; slightly sticky, slightly plastic; few, fine roots; extremely acid; gradual wavy boundary.

C2 — 26 - 50" — Light grey (5Y 7/1) silty clay with many large, prominent dark red concretionary mottles and common, medium, prominent yellowish brown mottles; medium and coarse angular blocky structure; slightly sticky, slightly plastic; few, fine roots; extremely acid.

Type Location: About 4 miles west of Ikuruwa Creek and 6 miles south of Canje River, Berbice County, British Guiana.

Range in Characteristics: Colour of the surface soil ranges from very dark grey to brown. The depth to reticulate red and grey mottling ranges from 24 to 36 inches.

Competing series and their differentiae: Native vegetation is savannah grasses. Dageraad soils have better natural drainage and less mottling in the upper subsoil than the Nassau (57), Helvetia (52), or the Kamani (53) soils, which also developed in savannah areas. They lack the fragipan that is present in Kamani soils (53). Dageraad soils are somewhat less well drained, and so have mottling at a more shallow depth, than Yesi soils (158), which developed under forests. They probably have a lower level of natural fertility than the Yesi soils.

Setting: Dageraad soils developed under cover of grasses in old, leached silty sediments of the alluvial terraces known as the Coropina formation. Dissection has produced undulating topography, with slopes varying from 1 or 2 to about 5 percent, but mostly less than 3 percent. The substratum is silty clay or silty clay loam.

Principal Associated soils: In adjoining, less well drained places are soils of the Nassau (57), Helvetia (52), Kamani (53) and Vigilante (54) series. Nearby, but mostly under forest in their native state, are soils of the Yesi (150), Potoco (157), Torani (153) and Putkin (156) series.

Drainage and Permeability: The class of natural drainage is well drained or moderately well drained. Surface drainage is medium. Permeability is moderate.

Vegetation and Use: Native vegetation is savannah grasses and other savannah plants. Most areas are used for pasture. With lime and fertilizer the soils probably are well suited or moderately well suited for most of the commonly grown crops except rice. Capability subclass IIf.

Distribution and Extent: In savannah areas on silty alluvial terraces, near the inner margin of the coastal plain, close to the more sloping sandy soil, in northastern British Guiana.

Series Established: Soil Survey of Canje Area, British Guiana, 1963.

Remarks: Differentiae from soils of the Yesi (158) series should be investigated. Possibly the two series should be correlated as one.

Source: Soil Survey of the Canje Area, British Guiana, by Robert Brinkman, 1964. Arranged in this form by J. G. Steele, July 1965.

Dead Man Swamp Series

The Dead Man Swamp soils are members of a clayey, isothermal family of Typic Umbraquults. They are also classified as Humic Gley soils, very poorly drained. Their surface soil is black clayey muck, and the subsurface soil and subsoil are greyish brown or light brown clay.

Typifying pedon: Profile of Dead Man Swamp clay.

0 - 6" — (10YR 2/1); black very humic clayey muck; many roots; weak, medium, crumb structure.

6 - 22" — (10YR 5/2); greyish brown clay to heavy clay; structureless; few rust lined root channels; roots common.

22 - 50" — (2.5Y 6/2); light brownish grey clay; common faint yellow mottling; structureless.

Type location: Rupununi Savannahs in Southwestern British Guiana.

Range in Characteristics: Not given in the description available in 1965.

Competing series and their differentiae: Apparently more humic and darker coloured than Long Man Swamp soils.

Setting: Dead Man Swamp soils occupy depressions in the low flats, and are surrounded by areas of Ambrose soils.

Principal Associated soils: Ambrose soils are in adjacent slightly higher places. Kuma, Emprensa, and Makushi soils are in the same localities.

Drainage and permeability: Poorly drained. The soils are under water for a long time during the rainy season but the water table was observed to be at 30 inches in November. Very slowly permeable; the clay subsoil keeps the soil wetlong into the dry season.

Vegetation and Use: Vegetation on the site described and sampled was mostly sedges. Use is limited by the long period of flooding and by the lack of any reserve of soil fertility.

Distribution and extent: About 7 square miles in the area covered by soil surveys. Further extent is not known, but small areas probably are present in depressions throughout the savannahs.

Series Established: Soil Survey of the Rupununi Savannahs, published 1958.

Remarks: None.

Source: Soil Survey of the Rupununi Savannahs. Soil and Land Use Survey No. 2. British Guiana,by the Regional Research Centre, ICTA, Trinidad, March, 1958; arranged in this form by J. G. Steele, November, 1965.

De Velde series 1

In the De Velde series are soils classified as Aquic Haplorthents, members of a clayey, acid, family (Low Humic Gley, poorly drained or somewhat poorly drained). The surface soil is greyish brown to brown clay, silty clay loam, or silt loam. The subsoil is grey and strongly mottled.

Typical profile of De Velde clay in a forested area.

Ap -- 0 - 4" -- Grey (10YR 5/1) clay; few, fine, distinct dark brown mottles around root channels; weak, medium granular structure; slightly sticky, slightly plastic, numerous fine roots; mildly alkaline; clear, smooth boundary.

C1g -- 4 - 15" -- Grey (5Y 6/1) clay with common, medium prominent yellowish brown mottles; massive to weak medium subangular blocky structure; sticky and plastic; fine roots; common neutral; gradual, wavy boundary.

C2g -- 15 - 34" -- Grey (5Y 6/1) clay with many, medium, prominent yellowish brown and brownish yellow mottles; massive structure sticky and plastic; fine roots, common neutral; gradual, wavy boundary.

Type location: Berbice County, British Guiana, 300 feet west of Berbice River, 18 miles southeast of New Amsterdam.

Range in Characteristics: Texture of the surface soil is clay, silty clay, silty clay loam, or silt loam. Colour of the A horizon ranges from brown to very dark grey and that of the subsoil (C2g) from grey to light brownish grey. Mottles in the C horizons are mostly common, fine, and distinct but in some places are many, medium and distinct; they range in colour from dark brown to yellowish red. In some places the soil is strongly acid to a depth of 4 feet. Structure of the clay horizons is weak to moderate subangular blocky. In some places the soil below 36 inches is marine clay that has a high content of soluble salts. A saline phase has been recognized where the soil has been flooded recently with brackish water. In some places the subsoil is silty or contains layers of silt. Colours given are for the moist soil; if the soil dries, colour values are one or two units higher.

Competing series and their differentiae: De Velde soils are more friable than Everton soils (31a) and the subsoil has weaker, less prominent structure. They are more friable, less acid in the subsoil, and have weaker structure in the subsoil than Canje soils (31). They have slightly better natural drainage than Black Bush soils (3), and lack the streaks and spots of segregated iron that are common in the surface horizon of soils of that series. They have lighter coloured surface soil and contain less organic matter than Plegt Anker soils (5). They are less well drained and so are more grey and have more mottles in the subsurface layer than the Moleson soils (8). Similar soils underlain by soft cat clay are classified in the Tuschen series if the depth to cat clay is 36 - 60 inches.

Setting: De Velde soils consist of fine-grained, alluvial materials along streams in the coastal areas that contain or have contained some brackish water. They generally occupy the natural levees close to the river or to an old channel, and are slightly higher and better drained than the soils further back. Topography is nearly level. The substratum in many places is soft clay of marine origin. Kawfootoes 4 to 8 inches high are common.

Principal Associated soils: Associated in many places with the more developed Canje (31) or Everton (31a) soils, and with Corentyne (11) and Moleson (8) soils in other places with Tuschen soils (39) or Brickery soils (36) that are underlain with soft, marine clay that contains organic matter.

Drainage and Permeability: Poorly drained or somewhat poorly drained. Surface runoff is slow. Permeability is very slow or slow.

Vegetation and Use: Native vegetation is tropical rain forest that contains kokerite palm, long john, congo pump, trysil, white cedar, manicole, wild plantain, razor grass and moco-moco. A large part is in primary or secondary forest. Cleared areas are used for rice, corn, coconuts, citrus, vegetables, bananas, and sugar cane. Shifting cultivation is common. Crops respond well to drainage and fertilizer. To maintain good yields and avoid the need for renewal by growth of bush, organic matter, lime and fertilizer are all needed. Capability subclass If.

Distribution and Extent: Along rivers and large creeks in the coastal plain of British Guiana and probably Surinam.

Series established: Soil Survey of Mahaica-Mahaicony-Abary area, 1963.

Remarks: The soil and underlying layers are stratified and show little soil development. The clay and the silt might be classified in different families of the new classification, but the silt loam is likely to have subsoil of silty clay loam, and most profiles probably meet requirements for a clayey family.

Source: Described by Glenn H. Robinson, 30.4.63. Other descriptions are in soil surveys of 1964 and 1965. Arranged in this form by J. G. Steele, August, 1965.

Durban Series

In the Durban series are soils classified (tentatively) as Oxic Normudults, members of a clayey family (well-drained, Red-Yellow Podzolic soils). The soils typically have a surface layer of sandy loam or sandy clay loam and a subsoil of reddish yellow to red sandy clay loam or sandy clay, and are underlain by sandy clay derived from weathered granite.

Typical Profile, near Durban landing on the right bank of the Mazaruni River on the top of a slope.

0 - 5"	Dark yellowish-brown (10YR 4/4) sandy loam to sandy clay loam; subangular blocky structure; friable; containing small pieces of charcoal; roots very common.
5 - 13"	Yellowish-brown (10YR 5/8) sandy clay loam; subangular blocky structure; common, fine, iron coated quartz gravel; roots common.
13 - 17"	Reddish-yellow (7.5YR 6/8) sandy clay loam with common faint (2.5YR 6/8) light red mottles; subangular blocky structure with common large iron coated quartz crystals; few roots.
17 - 29"	Light red to red (2.5YR 6/8 to 2.5YR 5/6) sandy clay; subangular blocky structure; frequent large iron coated quartz crystals.
29 - 65"	Reddish-yellow (5YR 6/6) sandy clay strongly mottled with pure white, kaolinitic type clay; very frequent large quartz crystals.

Type Location: Near Bartica, between Mazaruni and Essequibo Rivers.

Range in Characteristics: To be defined after further studies in the field.

Competing Series and their Differentiae: To be defined. Distinctions from the Wauna series need to be stablished.

Setting: The soils are on rocks containing mostly acid components (granite) but some basic components such as hornblende schist.

Principal Associated Soils: Sandy soils of the Tiwiwid and the Kasarama series lie at slightly higher locations in the Bartica triangle. Tiger Creek soils are in areas of basic rocks.

Drainage and Permeability: The soils were described by Stark and others(1959) as moderately well to imperfectly drained. Study of the published descriptions suggests that the drainage class as defined in the Soil Survey Manual might be well drained. Permeability is estimated to be moderate.

Vegetation and Use: Native vegetation is rain forest. Stark reports that the soil, when cleared of forest, acquired a thick carpet of Lucuntu grass, which furnishes grazing for cattle. He also reported that citrus has been planted in some places. A, B, and C slopes are estimated to be in capability subclass IIIe.

Distribution and Extent: Mapped in the Bartica Triangle, (1959). Distribution elsewhere remains to be determined. Probably is extensive in areas of granitic rock in the Northwest.

Series Established: Soil Survey of the Bartica Triangle, published 1959.

Remarks: This description was taken from the published soil survey cited below. Errors in the classification and in other judgements or extrapolations need to be corrected. The range of characteristics and distribution need to be established by means of field studies.

Source: Soil and Land Use Surveys No. 5, British Guiana Part 2. The Bartica Triangle. Imperial College of Tropical Agriculture, Trinidad, W.I., April, 1959. Compiled in this form by J. G. Steele, July, 1965.

Ebini Series 820

Soils of the Ebini series are classified as members of a moderately deep family of Oxic Normudults; also as Red-Yellow Podzolic soils, well drained. They have greyish brown or yellowish brown to dark greyish brown surface soil of sandy loam to clay loam; and yellow or yellowish red to strong brown subsoil of sandy clay or clay.

Typifying Pedon: Representative profile of Ebini sandy loam.

A1	0 - 3"	Very dark greyish brown (10YR 3/2) heavy sandy loam; moderate, coarse, granular structure; yellowish and white sand grains are common on surface; very friable; slightly plastic; many, medium and fine roots; worm casts are common, extremely acid, clear, smooth boundary.
A3	3 - 12"	Dark greyish brown (10YR 4/2) sandy clay loam; weak, medium, granular structure; friable; moderately plastic; some penetration of organic matter in root channels; few iron-manganese concretions about ¼ inch in diameter; extremely acid; gradual, smooth boundary.
B2	12 - 16"	Yellowish brown (10YR 5/4) sandy clay loam; weak, subangular blocky to massive structure; friable moderately plastic, some penetration of organic matter in root channels; no clay films evident; few iron-manganese concretions about ¼ inch in diameter, extremely acid; gradual, smooth boundary.
B2	16 - 30"	Yellowish red (5YR 5/6) sandy clay; weak, subangular blocky to massive structure; friable, moderately plastic; firm in place; iron-manganese concretions are common; few fine roots; extremely acid; gradual, smooth boundary.
B3	30 - 36"	Yellowish red (5YR 5/8) sandy clay with red and yellowish brown mottles; massive; friable but firm in place; iron-manganese concretions are common; few roots; extremely acid; gradual smooth boundary.
C	36 - 48"	Red (2.5YR 4/8) clay; massive; friable; medium size white sand grains throughout the soil matrix; numerous iron-manganese concretions; extremely acid.

Type Location: The representative profile was described and sampled 2¼ miles northwest of Takama near the Berbice River.

Range in Characteristics: Colour of the surface soil ranges from very dark greyish brown to pale brown or light brownish grey; texture from sandy loam to clay loam. Colour of the subsoil ranges from strong brown or red to pale brown or yellowish brown, andtexture from sandy clay to clay. Depth to the C horizon ranges from as little as 30 inches to more than 48 inches. Few or common red or white concretionary mottles, or some laterite pebbles, are present at some places in the lower subsoil.

Competing Series and their Differentiae: Ebini soils are distinguished from Kasarama soils (810) by their subsoil of sandy clay or clay. They have better natural drainage and browner or redder, less grey subsoil than Arima (750) or Aroaima (725) soils.

Setting: Ebini soils developed in fine-textured sediments of the Berbice formation. They are undulating or gently sloping; slopes are less than 3 percent in most places, but are steeper near some of the streams. Ant hills, most of them abandoned, are common in the savannah areas.

Principal Associated Soils: Kasarama soils (810) and Tabela soils (800) are associated, more sandy soils. Soils of these three series do not form a definite pattern; the soil in each locality must be examined to learn which series is present. Other associated soils, in drainage ways and depressions, are those of the Arima (750) and the Aroaima (725) series.

Drainage and Permeability: Well drained; probably moderately permeable.

Vegetation and Use: Vegetation is partly savannah but in most places is evergreen forest. The soils are easy to work, and have good structure and good water-holding capacity. They are extremely low in all the plant nutrients, and have rather low capacity to retain added fertilizers. The soils are well suited for most tree crops except cocoa or coffee, and for pineapples and tobacco, and moderately suited for most other crops and for pasture. Lime and fertilizer are essential. Irrigation would make yields more dependable, especially of annual crops, but the production that can be obtained in regular rainy seasons needs to be ascertained. Control of runoff is essential to prevent erosion, even on slopes of 2 or 3 percent. "A" slopes are in capability subclass IIf.

Distribution and Extent: Ebini soils make up about 16 percent of the sandy land covered by the soil survey of the Ebini-Ituni-Kwakwani Area. They probably are moderately extensive throughout the area of gently sloping brown sandy soils in northeastern British Guiana.

Series Established: Soil Survey, Ebini-Ituni-Kwakwani Area, 1963.

Remarks: The Ebini series now includes the soils formerly classified in the Halchica series (720). Halchica soils were described as slightly lighter coloured than Ebini soils, but had the same range of other characteristics.

Source: Compiled from Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary release 1964. Arranged in this form by J. G. Steele, December, 1965.

Emprensa Series

The Emprensa soils are members of a coarse loamy, acid family of Typic Haplorthents. They are also classified as Regosols grading toward Red-Yellow Podzolic soils, and are well drained. The soils consist of very dark greyish brown sandy loam over dark brown to yellowish brown loamy sand or sandy loam, on very gentle or gently rolling slopes.

Typifying pedon: Emprensa sandy loam on a gentle slope.

0 - 5" -- Very dark greyish brown (10YR 3/2) slightly sandy loam; structureless.

5 - 15" -- Dark brown (10YR 4/3) loamy sand; soft, structureless.

15 - 30" -- Dark yellowish brown (10YR 4/4) sandy loam; structureless; few roots.

30 - 72" -- Yellowish brown (10YR 5/6) sandy loam; structureless; few roots.

Type location: Near Takutu River and Sawariwau River in Rupununi Savannahs.

Range in Characteristics: Not available in 1965.

Competing series and their differentiae: Not stated in the description available in 1965.

Setting: The Emprensa-Makushi association, mapped on the soil survey, lies as a topographic intermediate between the Kaput-Waruma association at a higher level and the lower Ambrose-Dead Man Swamp Association. About 75 percent of the area mapped in this association is occupied by the Emprensa series.

Principal Associated soils: Makushi soils are in the small depressions, which are called baixas. Kaput and Waruma soils lie on the slopes at a higher level, and Ambrose and Dead Man Swamp soils lie below.

Drainage and Permeability: Emprensa soils are well drained and probably rapidly permeable, but the subsoil contains enough clay to give some impedance to water movement. Adjacent Makushi soils in the small depressions are somewhat poorly drained.

Vegetation and Use: Vegetation is savannah grasses and shrubs. The site described was occupied mainly by Curtella americana. Used for grazing, but furnishes no forage during the dry season. The surface soil layers are highly leached and readily dry out, and grass growth in the dry season is coarse and worthless as cattle feed.

Distribution and Extent: Extensive, about 133 square miles in the Rupununi Savannahs. Further extent not known in 1965.

Series Established: Soil Survey of Rupununi savannahs, published 1958.

Remarks: None

Source: Soil Survey of the Rupununi Savannahs, Soil and Land Use Survey No. 2., British Guiana. Regional Research Centre at ICTA, Trinidad, March, 1958. Arranged in this form by J. G. Steele, November, 1965.

Everton Series 31a

The Everton series consists of soils classified as Typic Ochraquults, members of a clayey, acid, moderately permeable family (poorly drained, Low Humic Gley). They have very dark grey clay surface soil over mottled grey and brownish yellow, strong brown, or yellowish red, friable subsoil.

Typifying pedon: Typical profile of Everton clay, cultivated.

Ap — 0 - 6" — Very dark grey (10YR 3/1) clay; medium to coarse granular structure; slightly sticky, slightly plastic; contains many fine roots; extremely acid; abrupt, smooth boundary. 5 to 7 inches thick.

A3g — 6 - 22" — Dark grey (10YR 4/1) clay mottled with yellowish red (5YR 4/8); mottles are common, fine and distinct and occur mainly along root channels; medium, subangular blocky structure; non sticky; plastic; containing many fine roots and a few old cracks with infillings of darker coloured A1 material; extremely acid; clear, smooth boundary.

B2g — 22 - 28" — Grey (5Y 6/1) clay mottled with brownish yellow and some red; mottles are many, fine to medium and prominent; moderate medium subangular blocky structure; non sticky, plastic; containing thin lenses of silty material and many fine old roots; very strongly acid; gradual, wavy boundary.

B3g — 28 - 48" — Grey (5Y 6/1) clay mottled with strong brown (7.5YR 5/8); mottles are many, fine to medium and prominent and occur mainly along root channels; massive structure; non sticky; plastic; slightly acid; gradual, wavy boundary.

Cg — 48 - 60" — Greenish grey (5BG 6/1) silty clay loam mottled with olive and dark yellowish brown; mottles are common, medium and prominent; massive structure; non sticky, plastic; mildly alkaline.

Type Location: Along west bank of Abary River, one mile north of the mouth of Wiruni creek, Demerara County, British Guiana.

Range in Characteristics: The principal types are clay and silty clay loam. Colour of the A horizon ranges from very dark grey to grey. The B horizon in most places is grey with many mottles of strong brown to yellowish red. The substratum can be silt or clay with pH of 5 to 7. Soluble salts can be present in the substratum and also in the B horizon. Natural drainage ranges from poorly drained to the wettest part of the somewhat poorly drained class. If soil dries, colour values are from one to two units higher than those given for moist soil.

Competing series and their differentiae: Everton soils have a more friable B horizon, a less acid B horizon and C horizon, and are more fertile than the Canje (31) soils. They have a thinner A1 horizon and a less acid C horizon than the Kerkenama (32) soils. Structure of the B horizon is more prominent than in the subsoil of the De Velde (1c or 1s) soils.

Setting: Everton soils are on old natural levees along streams in the coastal section. As a rule they are slightly lower than Canje soils (31). They developed in fine-textured alluvium that probably was washed chiefly from the Coropina and White Sand formations but contains some sediments from the muddy, brackish water along the coast. The soils are nearly level or are in slight depressions. Kawfootoes (small hummocks) six to eight inches high are common in most areas.

Principal Associated soils: De Velde (1c and 1s) soils lie slightly lower and are a little more affected by floods at high tides if not protected. Canje (31) soils are slightly higher and have more strongly developed, less permeable subsoil. Other associated soils are Brandwagt (32a) and Bath (43a).

Drainage and Permeability: Poorly drained or marginal to somewhat poorly drained; slow runoff, moderately slow internal drainage, moderate permeability. Low shrink-swell ratio.

Use and Vegetation: A large part is in tropical rain forest of long john, mucru, congo pump, Kokerite, silk cotton, wild plantain, trysil, and several kinds of low growing bushes.

Cleared areas are used for rice, sugar cane, bananas, plantains, ground provisions, and vegetables. Shifting cultivation is common. The soil responds well to drainage and to lime and fertilizer. It holds moisture well. With proper management, moderate to high yields of the suitable crops can be expected. Capability Subclass If.

Distribution and Extent: Just above the present flood plain of streams in the coastal section. The total extent is nearly 360,000 acres.

Series Established: Mahaica-Mahaicony-Abary Area, 1963.

Remarks: None.

Source: Based on descriptions by G. H. Robinson, Robert Brinkman, and C. C. Applewhite, 1964. Arranged in this form by J. G. Steele, May, 1965.

Fairfield Series 147

Soils of the Fairfield series are classified as members of a clayey, acid, soft or moderately firm family of Aquic Haplorthents; also as Low Humic Gley soils, poorly drained. They have a surface soil of dark grey or very dark grey, very strongly acid clay, and a subsoil of clay that is greenish grey mottled with strong brown and yellowish red, and is very strongly acid. The soil contains a moderately high amount of soluble salts, and in some places contains toxic sulphates.

Typifying Pedon: Typical profile of Fairfield clay.

A1	0 - 8"	Dark grey (10YR 4/1) clay; coarse, angular blocky structure; firm; many fine roots; extremely acid; clear, wavy boundary.
B2g	8 - 17"	Grey (5Y 5/1) clay mottled with light olive brown and olive brown; mottles are many, fine and distinct; coarse, angular blocky structure; slightly plastic; fine roots are common; clay skins occur along the faces of some cracks; neutral; clear, smooth boundary.
B3g	17 - 29"	Greenish grey (5GY 6/1) clay mottled with yellowish brown and light olive brown; mottles are many, fine and distinct; coarse angular blocky structure; plastic, non sticky; few fine roots; neutral; gradual, wavy boundary.
C1g	29 - 40"	Greenish grey (5GY 6/1) clay mottled with strong brown and brownish yellow; mottles are common, medium and prominent; massive; soft; plastic, slightly sticky; concretionary root pipes common;mildly alkaline; gradual, wavy boundary.
C2g	40 - 48"	Greenish grey (5GY 6/1) clay mottled with light olive brown and brownish yellow; mottles are common, medium and prominent; massive; soft; slightly sticky, plastic; concretionary root pipes common, mildly alkaline.

Type Location: The typical profile was described west of Fairfield Dam, 2 miles south of the railroad, east of the Mahaica River.

Range in Characteristics: Colour of the surface soil is dark grey or very dark grey. Reaction of the deep subsoil and substratum may be acid, neutral or alkaline, but it is likely to become acid on drying. In some places the substratum contains toxic sulphates.

Competing Series and their Differentiae: Fairfield soils are less poorly drained than Weldaad (44) soils), and the colour of the surface soil is not so dark.

Setting: Fairfield soils are in areas of soft marine clays known as frontland clays. The substratum in many places contains toxic sulphates.

Principal Associated Soils: Associated soils are mainly those of the Rosignol (43) Onverwagt (41) and Lichfield (42) series, which have firmer subsoil, and Weldaad soils (44) in depressions where the surface layer is darker.

Drainage and Permeability: Poorly drained, probably slowly permeable.

Vegetation and Use: Native vegetation was water tolerant trees and marsh plants. Because the soils are very strongly acid, have a low content of plant nutrients, and in many places contain salts, they are poorly suited for most crops. After leaching of soluble salts and additions of lime and complete fertilizer, they would be moderately suited for coconuts, sugar cane, and ground provisions. Capability subclass IIs.

Distribution and Extent: Fairfield soils occupy less than 10 square miles in the area covered by soil surveys. Their extent in areas still to be surveyed probably is not much greater.

Series Established: Soil Survey of Mahaica-Mahaicony-Abary Area, 1963.

Remarks: None.

Source: Taken from soil survey reports of Mahaica-Mahaicony-Abary Area and Canje Area, both released in preliminary form 1964. Arranged in this form by J. G. Steele, November, 1965.

Halchica Series 720

The Halchica series, described in the Soil Survey of the Ebini-Ituni-Kwakwani Area (1964) is identical with the Ebini series except for slightly lighter colour. It was combined with the Ebini series in 1965.

Haswell Series 25

Soils of the Haswell series are classified as members of a clayey, acid, soft or moderately firm family of Aquic Haplorthents; also as Low HumicGley soils, poorly drained. They have a grey or dark grey, extremely acid surface soil and a very strongly acid firm clay subsoil that is grey mottled with yellowish brown. The substratum is acid grey clay.

Typifying pedon: Profile of Haswell clay.

Ap — 0 - 13" — Grey (10YR 5/1) clay, with common, fine distinct brown, yellowish brown and very dark grey mottles; massive structure; firm sticky and plastic; many fine fibrous roots; very strongly acid; clear smooth boundary.

B2g -- 13 - 26" -- Grey (5Y 6/1) clay, with common, medium prominent yellowish brown and brownish yellow mottles; massive structure; firm, sticky and plastic; occasional fine roots; very strongly acid; clear smooth boundary.

Clg — 26 - 38" — Grey (5Y 6/1) clay, with common, medium, prominent yellowish brown, yellow and brownish yellow mottles; massive structure; sticky and plastic; few old root channels; few soft concretionary root pipes; extremely acid; gradual, wavy boundary.

C2g — 38 - 46" — Grey (5Y 6/1) clay, with common, medium prominent yellowish brown and light yellowish brown mottles; massive structure; sticky and plastic; few old root channels; extremely acid; gradual, wavy, boundary.

C3g — 46 - 54"+ — Grey (5Y 6/1) clay, massive structure; sticky and plastic; extremely acid.

Typelocation: The profile described is located about 3 miles south of Gibraltar on the west side of Albion Estate.

Range in Characteristics: The content of soluble salts and of acid sulphates is variable from place to place.

Competing series and their differentiae: Haswell soils have a firmer B horizon and higher salt content than the Skeldon (13) or the Whittaker (37) soils. They contain acid sulphates in some places, but Skeldon and Whittaker soils do not. The subsoil is firmer than that of Fairfield clay (147).

Setting: Haswell soils are in slight depressions between sandy ridges of the marine coastal plain.

Principal associated soils: Ithaca (72) and Whim (75) soils are on sandy ridges. Skeldon (13) and Whittaker (37) soils are in nearby level areas where the subsoil is moderately firm but the substratum is soft clay, and acid sulphates are not present.

Drainage and Permeability: Poorly drained, probably slowly permeable. Leaching of salts is moderately difficult.

Vegetation and Use: Native vegetation was marsh plants and some water-tolerant trees. After drainage and after leaching of soluble salts the soils are moderately well suited for rice, sugar cane, ground provisions, or coconuts. Capability subclass IIs.

Distribution and Extent: Haswell soils occupy about 1360 acres in the areas covered by soil surveys, and possibly a few square miles more in the areas still to be surveyed, all in the coastal plain of Northeastern British Guiana.

Series Established: Soil survey of the Canje Area, 1963-64.

Remarks: None.

Source: Soil Survey, Canje Area, by Robert Brinkman, F.A.O. Released in preliminary form 1964. Description arranged in this form by J. G. Steele, November, 1965.

Helvetia series 52

In the Helvetia series are soils classified as Ochric Plinthaquults, members of a fine silty, moderately permeable family (Low Humic Gley-Ground-Water Laterite intergrade, poorly drained). The surface soil is very dark grey silt loam. The subsoil is light grey silt loam mottled with dark red and reddish yellow.

Typifying pedon: Profile of Helvetia silt loam.

A1 — 0 - 12" — Dark grey (10YR 4/1) silt loam; weak, very fine granular structure; very friable, non sticky, non plastic; numerous fine roots; extremely acid; clear, smooth boundary.

A3 — 12 - 20" — Dark grey (10YR 4/1) silt loam with few, fine distinct light grey and black mottles; weak fine granular structure; very friable; non sticky, non plastic; common fine roots; extremely acid; clear, wavy boundary.

B21g — 20 - 26" — Light grey (5Y 7/1) silt loam with common, fine, prominent strong brown mottles; weak, fine subangular blocky structure; friable; some penetration of topsoil in small pockets; non sticky, non plastic; fine roots common; extremely acid; gradual; smooth boundary.

B22g — 26 - 38" — Light grey (5Y 7/1) silt loam with common, medium, prominent strong brown and yellow brown mottles; soil breaks into irregular shaped blocks with thin clay films on vertical faces; slightly sticky, slightly plastic; common fine roots; extremely acid; gradual, wavy boundary.

C1g — 38 - 55" — Light grey (5Y 7/2) silty clay loam with common large, prominent dark red and reddish yellow mottles; soil breaks into irregular blocks; slightly sticky; slightly plastic; occasional fine roots; hard and soft concretions are common; extremely acid; gradual, wavy boundary.

C2g — 55 - 66"+ — Light grey (5Y 7/2) silty clay loam with common, large, prominent dark red and reddish yellow mottles; soil breaks into irregular blocks; slightly sticky; slightly plastic; occasional fine roots; hard and soft concretions are common; extremely acid; gradual, wavy boundary.

Type location: Two miles northwest of De Velde near Berbice River, British Guiana.

Range in Characteristics: Colour of the surface soil ranges from dark grey to brown. Texture of the surface soil ranges from silt to silty clay loam. Texture of the deep subsoil substratum ranges from silt loam to silty clay. The depth to dark red mottling is 20 to 38 inches.

Competing series and theur differentiae: Helvetia soils are slightly lower and less well drained and therefore more mottled than Nassau soils (57). They are better drained and less grey than Vigilante soils (54) and the surface soil is not so dark. They resemble Cola soils (152) but have native vegetation of grasses and probably have a somewhat lower level of natural fertility.

Setting: Helvetia soils are on very gentle slopes, in many places on broad flats around the heads of drainageways, on the old, silty terraces known as the Coropina formation. The deep substratum ranges from silt loam to silty clay.

Principal Associated soils: Associated mostly with the better drained Nassau (57) and Potoco (157) soils.

Drainage and Permeability: Poorly drained. Surface drainage is slow. Permeability probably is moderate.

Vegetation and Use: Native vegetation is grasses and other savannah plants. Many areas are used for pasture. Low hummocks, called kawfootoes, are probably formed by trampling of animals. Water stands in some places during the rainy season, but drainage by bedding and surface ditches should not be difficult. With drainage, lime and fertilizer, moderate or good yields of citrus, bananas, cashew nuts, ground provisions, and some other crops should be obtainable. Capability subclass IIw.

Distribution and Extent: In nearly level of very gently sloping places on the old alluvial terraces known as the Coropina formation, near the inner margin of the coastal plain, not far from the more sloping sandy soils, in northeastern British Guiana.

Series Established: Soil Survey of Canje Area, British Guiana, 1963.

Remarks: This description and the one of Cola soils (152) are similar. Soils of the two series should be examined for possible correlation in one series.

Source: Soil Survey of the Canje Area, British Guiana, by Robert Brinkman, 1964. Arranged in this form by J. G. Steele, July, 1965.

Henrietta Series 730

Soils of the Henrietta series are classified as members of an acid family of Typic Aquipsamments; and as Low Humic Gley soils, poorly drained. They have a surface soil of dark grey to very dark grey sand over subsoil of light brownish grey to grey sand.

Typifying pedon: Representative profile of Henrietta sand.

A1 -- 0 - 7" — Very dark grey (10YR 3/1) loamy sand; weak, fine, granular structure; very friable; common, fine, medium and large roots; white sand grains abundant; extremely acid; gradual boundary.

A3 — 7 - 12" — Dark grey (10YR 4/1) loamy sand; structureless; very friable; common fine and few medium roots; white sand grains present though in a lesser amount than in the A1 horizon; extremely acid; gradual boundary.

C1g — 12 - 26" — Grey (10YR 5/1) sand; structureless; very friable; few fine roots; number of white sand grains decreasing below 15"; extremely acid; clear smooth boundary.

C2g — 26 - 42" — Grey (10YR 6/1) sand; structureless; few fine roots; extremely acid; clear smooth boundary.

C3g — 42"+ — Light grey (10YR 7/2) medium to coarse sand; structureless; occasional fine roots; extremely acid.

Type location: The representative profile was described and sampled 4-3/4 miles west of the Berbice River and 6 miles south of Ituni creek in northeastern British Guiana.

Range in Characteristics: In some places a thin layer of organic matter lies on the mineral soil. Colour of the surface ranges from black to very dark grey. Thickness of the dark layer ranges from 7 to 12 inches. Colour of the subsoil ranges from light grey to pale brown. Texture throughout the profile is sand or loamy sand.

Competing series and their differentiae: Henrietta soils lack the cemented pan that is characteristic of Ituni soils (701). They do not have the thick dark-coloured surface layer that is characteristic of Siparuta soils (732). They are more poorly drained than Tabela soils (800), and more sandy than Mibirikuru soils (740).

Setting: Henrietta soils are along small streams and in depressions or potholes, in undulating sandy sediments of the Berbice formation.

Principal Associated soils: Tabela (800) Tiwiwid (700) and Kasarama soils (810) are in associated higher positions.

Drainage and Permeability: Very poorly drained. The sand is rapidly permeable, but as a rule is underlain by slowly permeable clay or clay loam.

Vegetation and Use: Native vegetation is part forest and part savannah. In savannah areas trees are likely to grow in low places where these soils or other poorly drained soils are located. Because of seasonal wetness and the lack of outlets for artificial drainage, Henrietta soils are not suited for the common crops. Some pasture might be available during the dry season. Land Capability subclass IVw.

Distribution and Extent: Henrietta soils occupy about 5,000 acres in the Ebini-Ituni-Kwakwani soil survey area. They no doubt occupy a relatively small but significant acreage along small streams and in depressions throughout the gently sloping, sandy plains.

Series Established: Soil Survey, Ebini-Ituni-Kwakwani Area, 1963.

Remarks: None

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary report May 1964. Compiled in this form by J. G. Steele, January, 1966.

Hosororo Series, 340

Soils of the Hosororo series are classified as members of a clayey family of Oxic Normudults and in the classification of 1938 as Reddish Brown Lateritic well drained. The surface soil in most places is dark brown to strong brown clay to silt loam or loam, with variable content of gravel and stones. The subsoil is red to brown clay to silty clay loam, in some places gravelly or stony. Horizons are not distinct. Fragments and outcrops of hard ironstone are common. Fragments or boulders of weathered basic rocks are present in some places.

Typifying Pedon: Representative profile of Hosororo silty clay.

0 - 4"	Dark brown (7.5YR 4/4) silty clay loam to silty clay; weak to moderate, medium, granular structure; friable; slightly sticky, and non plastic; numerous fine and occasional medium roots; few fine to medium coarse black (N/2) lateritic iron stone pebbles; gradual, smooth boundary.
4 - 14"	Yellowish red (5YR 4/6) silty clay loam to silty clay; moderate, medium, (but weak in places) granular structure; friable; slightly sticky and slightly plastic; common, medium and few, coarse black (N/2) lateritic iron stone pebbles, some with smooth and some with very rough edges, few ironstone, yellowish red (5YR 5/8) concretions, few and fine bits of charcoal scattered; few fine roots; gradual, smooth boundary.
14 - 28"	Yellowish red (5YR 4/8) clay with traces of silt; weak, medium, granular structure (breaks into irregular clods in places); friable; slightly sticky and slightly plastic, many, medium and few very coarse black (N/2) ironstone pebbles, few yellowish red (5YR 5/8) concretions; fine roots are common; gradual, smooth boundary.
28 - 40"	Red (2.5YR 4/6) clay; massive structure but breaks into irregular blocks; friable; slightly sticky and plastic; medium, black (N/2) ironstone pebbles are common; occasional coarse and few fine roots; smooth and diffuse boundary.
40"+	Red (2.5YR 4/6) clay loam, massive structure but breaks into irregular blocks; slightly sticky and slightly plastic; medium black (N/2) ironstone pebbles are common, coarse pebbles are few.

Range in Characteristics: Texture of the surface soil ranges from clay through gravelly clay loam to silt loam. Colour of the subsoil ranges from dusky red to yellowish red. Content of gravel and stones is variable, but gravel does not make up more than 50 percent of the soil mass. Outcrops and boulders of hard laterite are present in many places.

Competing Series and their Differentiae: Horizons are less distinct than in the Wauna (350),Arakaka (360), and Durban soils. The gravel content is less and the clay content is greater than in Tiger Creek soils and in a gravelly Brown Latosol (Typic Udorthox) that probably will be named Kamarang. The base status is variable; pH values are generally less than 5.5. Published descriptions suggest that a high-base analogue might exist, but such a soil has not yet been observed with characteristics that permit separation at the series level.

Setting: Hosororo soils are hilly to mountainous, contain laterite outcrops or gravel, and generally are underlain by or contain weathered fragments of basic igneous rocks. The slope is less than 8 percent in a few small areas, but in most places is from 15 to more than 40 percent.

Principal Associated Soils: Intrusive rocks from hills or mountains in many parts of British Guiana. The Hosororo soils on them thus are associated with Wauna (350) Arakaka (340) and Durban soils in the Northwest, with Tiwiwid (700), Tabela (800), Kasarama (810) and other sandy soils in the undulating sandy plains, and with sandy or shallow soils in the plateau and mountains. Associated soils on laterite are those of the Kamarang and Tiger Creek series. Other associates in the hilly areas are the Lithosols and Regosols composed largely of laterite.

Drainage and Permeability: The soils are well drained, and probably are rapidly permeable.

Vegetation and Use: Native vegetation is dense forest. These soils are the most fertile in many of the upland parts of British Guiana, and are responsive to treatment. Rolling to steep slopes, boulders of primary rocks or of laterite, and the high content of stones and gravel limit cultivation in most areas. Where cultivation is possible, moderate yields can be obtained on new land for a few years without fertilizer. With fertilizer mulching, ground cover and control of erosion, a large number of crops probably can be grown year after year. Citrus fruits, avocados, coconuts and pasture grasses are growing well at Hosororo and at Mabaruma, but many of the trees are showing deficiency symptoms that no doubt would be corrected with proper fertilizer. Capability subclass of A, B and C slopes, IIIe.

Distribution and Extent: On scattered hills and mountains in all parts of British Guiana except the coastal plain and the major areas of white and brown sands. The Hosororo soils and their steep or rocky associates, however, make up only about 5 or 6 percent of the total area of the country.

Series Established: Wauna-Yarakita Area, 1966.

Remarks: Most of the soils classified as Reddish-brown Lateritic soils in the Reconnaissance soil Survey of British Guiana (1961-64) are members of the Hosororo series.

Sources: Observations by H. N. Ramdin and J. G. Steele in 1965 and 1966; and preliminary reports of the Reconnaissance Soil Survey by J. F. Derting, E. G. Braun and G. R. Suggett, 1964. Compiled in this form by J. G. Steele, March, 1966.

Huntley Series 253

Soils in the Huntley series are classified as members of a fine silty, slowly permeable family of Ochric Plinthaquults; also as Ground-Water Latcrite soils, poorly drained. They have a grey or light grey surface soil that is locally called catch-cow; and a subsoil of silty clay that is grey mottled with dark red.

Typifying pedon: Representative profile of Huntley silt.

A1 -- 0 - 5" -- Grey (10YR 6/1) and light grey (5Y 7/1) silt with few, fine, distinct, yellowish brown and yellowish red mottles; yellowish red mottles may occur around roots; massive structure; very dense; soft when moist, non sticky, non plastic; extremely acid; clear, smooth boundary.

B1 -- 5 - 9" -- Brownish yellow (10YR 6/8) silty clay loam mottled with grey and some red; mottles are many, medium and prominent; massive structure; firm, slightly sticky, plastic; few fine roots; extremely acid; clear smooth boundary.

B2g -- 9 - 30" -- Light grey (5Y 7/1) silty clay with many large, prominent dark red, red and some brownish yellow mottles; dark red mottles are present mainly as hard concretions; weak, coarse angular blocky; firm, slightly sticky, plastic; extremely acid; clear, smooth boundary.

C1g -- 30 - 42" -- Light grey (5Y 7/1) silty clay loam with common, medium, prominent brownish yellow and dark red mottles; massive; firm, slightly sticky, plastic; extremely acid; clear wavy boundary.

C2g -- 42 - 50" -- Light grey (5Y 7/1) silty clay with common, medium, prominent dark red and some brownish yellow mottles; the red is present mainly as large concretions; massive; firm, slightly sticky and plastic; extremely acid.

Type Location: This profile was described 1-3/4 miles east of dam alignment and 1/4 mile south of Mahaica River in Demerara, British Guiana.

Range in Characteristics: Texture of the subsoil and substratum ranges from silt loam to clay; depth to the red mottling from 18 to 30 inches; thickness of the silty surface layer from 4 to 10 inches.

Competing series and their differentiae: Huntley soils resemble Torani soils (153) but have a distinctive surface layer that contains more than 80 percent silt and has "catch-cow" (quicksand) properties. The subsoil and substratum resemble those of the Torani soils.

Setting: Huntley soils are in nearly level places, lower than most of the surrounding soils but not in enclosed basins, in areas of the old, silty terraces known as the Coropina formation.

Principal Associated soils: Soils of the Potoco (157), Torani (153), and Cola (152) series are on the adjacent, generally higher land. Vigilante soils (54) generally are in the drainageways.

Drainage and Permeability: The soils are poorly drained and probably slowly permeable.

Vegetation and Use: Native vegetation is mostly sparse grasses. The soil is extremely acid and very low in plant nutrients. The dense silt surface soil flows when wet and becomes very hard when dry, making the soil poorly suited for crops and for pasture. Capability subclass IIIm.

Distribution and Extent: Huntley soils occupy about 6,000 acres in the areas covered by semi-detailed soil surveys. Further extent is probably somewhat less than that already mapped.

Series Established: Mahaica-Mahaicony-Abary Area, 1962.

Remarks: None

Source: Taken from the preliminary report, Soil Survey of the Mahaica-Mahaicony-Abary Area by Clyde C. Applewhite, February, 1964. Arranged in this form by J. G. Steele, November, 1965.

Ikuribisi Series

In the Ikuribisi series are soils classified as Oxic Normudults, members of a deep, clayey family. In the classification of 1938 they are Red-Yellow Podzolic soils, moderately well drained. Typically the surface layer is brown sandy loam or loamy sand, the subsoil is pale brown sandy clay loam or sandy loam, and the substratum is sandy clay, apparently weathered granite.

Typifying Pedon: Representative profile of Ikuribisi sandy loam, in forest of wallaba, congo pump, and other trees.

A1	0 - 8"	Mottled, many fine, dark grey (10YR 4/1) and light brownish grey (10YR 6/2) sandy loam; fine, granular structure; friable; non sticky, non plastic; many fine, occasional large roots, clear smooth boundary; pH 4.5.
B1	8 - 13"	Greyish brown (10YR 5/2) sandy clay loam mottled with yellowish brown (10YR 5/6); mottles are few, fine, distinct and scattered; medium, subangular, blocky structure; slightly sticky, non plastic; scattered few (angular) fine quartz grains present; few medium and fine roots; gradual smooth boundary; pH 4.5.
B21	13 - 22"	Pale brown (10YR 6/3) sandy clay loam mottled with yellow (10YR 7/6); mottles are few, fine and faint; medium, subangular, blocky structure; slightly sticky non plastic; scattered few (angular) fine quartz grains present; thin clay films on the insides of large pores; occasional fine and medium roots; gradual smooth boundary pH 4.5.
C	28 - 35"	Light grey (10YR 7/2) clay mottled with yellowish brown (10YR 5/6), pale brown (10YR 6/3) and light yellowish brown (10YR 6/4); mottles are few medium and distinct medium, subangular, blocky structure; sticky; slightly plastic; pH 4.8.

Type Location: The soils were first mapped in the Bartica Triangle, between the Essequibo and the Mazaruni Rivers. The profile was described and sampled near Mahdia, between mile posts 109 and 110, about 20 feet east of the road.

Range in Characteristics: To be defined after further field studies. It is suggested that the series can include the somewhat poorly drained associate of the Arakaka soils.

Competing Series and their Differentiae: Yellow and brown mottling in the B horizon is more prominent than in Durban or Arakaka soils.

Setting: The soils are on gently or sloping uplands in the areas just north of Mahdia. More typically, they appear to lie on slopes that are underlain by clay weathered from light-coloured, fine-grained granitic rocks. Slopes range from gentle (3 to 8 percent) on the upland to moderately steep (15 to 25 percent) on the valley sides.

Principal Associated Soils: Durban soils and possibly Arakaka soils are in better drained locations. Tiwiwid soils (700) and Kasarama soils (810) are on uplands and upper slopes in the Bartica-Potaro areas. Marabunta Creek soils are on many of the slopes.

Drainage and Permeability: Moderately well drained or somewhat poorly drained, indicated by yellow and brown mottling in the subsoil. Surface drainage is medium to very rapid. Permeability is slow or very slow; water remains in the bottom of a 4-foot pit for a long time.

Vegetation and Use: Native vegetation is rain forest. The wetter locations carry more forest. Slopes steeper than 15 percent should not be cleared. Capability subclass, A and B slopes, IIf.

Distribution and Extent: Probably throughout the range of Durban and possibly of Arakaka soils, in Northwestern British Guiana.

Series Established: Soil Survey of Bartica Triangle, published 1959.

Remarks: It is suggested that the moderately well drained or somewhat poorly drained associates of the Arakaka soil can be correlated with the Ikuribisi series. Those soils are less pale and have more red mottling, and tend to occur on lower slopes and on benches.

Source: Soil and Land Use Surveys No. 5. I.C.T.A. Trinidad, 1959. Observations by H. N. Ramdin, J. G. Steel and others, 1965-66. Arranged in this form by J. G. Steele, March, 1966.

Inki Series 100

Soils of the Inki series are classified as members of a fine or clayey, moderately deep over peat, family of Aquic Haplorthents; also as Low Humic Gley soils, poorly drained. They have a surface soil of dark grey or dark greyish brown clay and a subsoil of grey clay mottled with yellowish brown over a substratum of peaty muck or peat. Depth of the mineral soil is 18 to 36 inches.

Typifying Pedon: Typical profile of Inki clay.

A1	0 - 4"	Dark grey (10YR 4/1) clay; fine, granular structure; non sticky; slightly plastic; medium and fine roots are common; extremely acid; clear, smooth boundary.
C1g	4 - 10"	Grey (10YR 6/1) clay; massive structure; slightly sticky, slightly plastic; some penetration of surface soil material from above; extremely acid; clear, smooth boundary.
C2g	10 - 18"	Grey (5Y 6/1) clay mottled with yellowish brown (10YR 5/8); mottles are common, medium and prominent; massive, sticky, plastic, some penetration of darker coloured material from the topsoil; extremely acid; clear smooth boundary.
C1b	18 - 28"	Very dark greyish brown (10YR 3/2) peaty muck; extremely acid; abrupt, smooth boundary.
C2b	28 - 48" +	Dark reddish brown (5YR 2/2) peat; extremely acid.

Type Location: South bank of Lama Creek, 1 mile west of Mahaica Creek, East Demerara.

Range in Characteristics: Colour of the surface soil is grey or dark grey. Thickness of the mineral soil ranges from 18 to 36 inches.

Competing Series and their Differentiae: The surface soil and subsoil resemble those of De Velde soils but the substratum is like that of Anira peat.

Setting: Inki soils consist of fine textured alluvial sediments over peat; along the banks of some of the smaller rivers and streams.

Principal Associated Soils: Most areas of Inki soils lie next to areas of Anira peat or Baiabo peat, along rivers or creeks where alluvium has been deposited over a substratum of peat.

Drainage and Permeability: Poorly drained, probably slowly permeable.

Vegetation and Use: Inki soils are strongly acid, difficult to drain, and low in phosphorus, calcium and potassium. Lime and complete fertilizer would be needed for crops. With lime and fertilizer, the soils would be moderately suited for some crops, probably rice, sugar cane, and pineapples. Land Capability subclass IIw.

Distribution and Extent: Inki soils occupy less than one square mile in the area covered by soil surveys, and probably are not extensive elsewhere.

Series Established: Soil Survey of Mahaica-Mahaicony-Abary Area, 1963.

Remarks: To cut down the number of series, these soils could be correlated as a peaty substratum phase of Brickery soils.

Source: Soil Survey, Mahaica-Mahaicony-Abary Area, released in preliminary form February, 1964. Arranged in this form by J. G. Steele, November, 1965.

Ireng Series

Ireng soils are members of a deep, fine-textured family of Oxic Normudults. They are also classified as Red- Yellow Podzolic soils, well drained. They have a surface soil of pale brown silty or fine sandy clay, a subsoil of brownish-yellow silty clay to sandy clay loam, and in some places a substratum of sandy loam.

Typifying Pedon: Profile of Ireng sandy clay.

0 - 16"	(10YR 6/3) pale brown, silty to fine sandy clay; medium angular blocky structure; hard, few roots.
16 - 24"	(10YR 6/6) brownish-yellow silty clay; weak, fine to medium, angular blocky structure; faint diffuse orange mottling.
24 - 54"	(10YR 6/8) brownish-yellow sandy clay loam; structureless, loose; a few fine hard red concretions.
54 - 72"	(7.5YR 5/5) strong brown sandy loam; structureless and loose; a few fine soft manganese concretions.

Type Location: Along the Ireng River in vicinity of Good Hope, Northern Rupununi Savannahs, South-western British Guiana.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: Not available in 1965. The series does not appear to overlap with any other described in soil surveys of the Rupununi Savannahs. The range in characteristics should be ascertained and recorded.

Competing Series and their Differentiae: Ireng soils lack the boulders of quartz and of magnetite that are characteristic of the Sawariuau soils.

Setting: Ireng soils are on the several terrace deposits along the Ireng River. The materials are stratified.

Principal Associated Soils: Benoni soils and Cachoeira soils are on the adjacent flats, away from the Ireng River.

Drainage and Permeability: Probably well drained and moderately or rapidly permeable.

Vegetation and Use: Orchard savannah of grasses, mainly Trachypogon plumosus and a few Curatella mericana. Soil water relationships apparently are better than on many of the soils of the savannahs.

Distribution and Extent: Ireng soils occupy about 13 square miles in the area covered by soil surveys: Further extent is not known in 1965.

Series Established: Soil survey of the Rupununi Savannahs (continued), published 1959.

Remarks: None

Source: Complied from Soil and Land Use Surveys No. 6, British Guiana, Regional Research Centre, I.C.T.A., Trinidad, June 1959. Arranged in this form by J. G. Steele, October, 1965.

Ithaca Series 72

Soils of the Ithaca series are classified (tentatively) as members of an acid family of Aquic Quartzipsamments; and as well drained or moderately well drained Regosols. They are variable but in many places have very strongly acid surface soil of dark brown fine sand to fine sandy loam, subsoil of slightly acid loamy fine sand to sandy loam, and a substratum of neutral or alkaline, stratified clay and sandy material.

Typifying Pedon: Representative profile of Ithaca loamy sand.

A1	0 - 8"	Yellowish brown (10YR 5/4) very fine sand; single grain structure; very friable; many, fine and few medium roots; extremely acid; clear, smooth boundary.
A3	8 - 16"	Yellowish brown (10YR 5/8) very fine sand with many medium and fine strong brown and few fine yellowish red mottles; single grain structure; very friable; common fine and medium roots; extremely acid; gradual, smooth boundary.
B1	16 - 28"	Strong brown (7.5YR 5/8) very fine sand mottled with yellowish brown; horizon contains many fine specks of grey sand; single grain structure; very friable; common medium and fine roots; very strongly acid; gradual, smooth boundary.
B2	28 - 35"	Strong brown (7.5YR 5/8) sandy loam mottled with yellowish brown; horizon contains many medium and fine very dark greyish brown specks; very weak, medium, subangular blocky structure; friable; clear, smooth boundary.
C1	35 - 43"	Yellowish brown (10YR 5/8) loamy fine sand with few large dark yellowish brown mottles; single grain structure; friable; medium alkaline; clear, smooth boundary.
C2	43 - 49"	Yellowish brown (10YR 5/8) loamy fine sand with few large dark brown mottles; single grain structure; friable; medium alkaline; clear, smooth boundary.
C3	49 - 54"	Greenish grey (5GY 6/1) sandy clay with some large sand pockets; common, medium and fine strong brown mottles along old root channels; massive structure; slightly plastic, slightly alkaline.

Type Location: The representative profile was described and sampled near the Corentyne River, about one-fourth mile south of Anamoronis Creek and 100' west of the Public Road.

Range in Characteristics: Partly because the total extent of the sandy ridges is relatively small, this series is described as having a fairly wide range of characteristics. Even so, many of the areas mapped are likely to contain inclusions of other, un-named soils. In Ithaca soils as they were defined in 1963, colour of the surface soil ranges from yellowish brown to dark greyish brown, and its texture is loamy sand or sand. Depth of the sandy material over clay ranges from 30 to 48 inches; the lower part in some places contains thin strata of clay; also in some places there are hard or soft concretions. The substratum in most places is alkaline. In some places the surface soil or subsoil contains shells. Soluble salts are in the substratum at some places.

Competing Series and their Differentiae: Ithaca soils are much more sandy, lie a little higher, and lack the thick, very dark surface soil that is characteristic of the Whim soils (75). They are less acid than the Novar soils which consist of deep sand or loamy sand.

Setting: Ithaca soils are on narrow, mostly discontinuous or interrupted strips of sand called reefs. The reefs are more or less parallel to the coast, lie slightly higher than the adjacent wet clay soils, and probably are old beaches. The substratum is clay, or stratified clay and sandy materials.

Principal Associated Soils: Ithaca soils in many places adjoin the sandy substratum phases of Onverwagt (41s), Rosignol (43s), Burton(45s) and Lichfield(42s) soils. Novar soils (70) are on similar ridges where the sand is deeper and is acid to a greater depth.

Drainage and Permeability: Ithaca soils are well drained or moderately well drained, and rapidly permeable.

Vegetation and Use: Native vegetation was forest. The soils are well suited for coconuts, and many of the ridges can be seen for a long distance because of the coconut trees growing on them. The soils have good physical properties but low fertility and low available moisture capacity. With lime, fertilizer, and irrigation water, moderate to good yields of many crops can be expected. The soils are well suited for ground provisions as well as for coconuts and moderately well suited for pasture. Capability subclass If.

Distribution and Extent: Ithaca soils occupy about 7,600 acres in the areas covered by semi-detailed soil surveys. A lesser acreage probably remains in the areas not yet covered.

Series Established: Soil Survey, Canje Area, 1963.

Remarks: As suggested under competing series, this series could be subdivided into several series if any need existed for more detailed classification of soils on the sandy ridges. For the present, it is believed that the Ithaca, Novar, and Whim series permit interpretations with a practical degree of refinement.

Source: Compiled from Soil Survey of the Canje Area and Soil Survey of the Mahaica-Mahaicony-Abary Area, released in preliminary drafts, 1964. Assembled in this form by J. G. Steele, December, 1965.

Ituni Series 701

Soils of the Ituni series are classified as members of a sandy family of Typic Thermaquods, and as Ground Water Podzols, poorly drained. The surface soil is dark grey to black sand. Beneath the surface layer is grey to very light grey sand that is usually wet, and is underlain by a very dark brown or almost black, sandy, compact, cemented layer.

Typifying Pedon: Representative profile of Ituni sand.

A1	0 - 5"	Very dark grey (10YR 3/1) medium sand with numerous white sand graihs; weak, fine granular structure due to organic matter content; very friable; many fine roots; extremely acid, clear, smooth boundary.
A12	5 - 8"	Dark grey, grading to grey (10YR 4/1 - 5/1) medium sand; single grain structure; loose, common fine roots; extremely acid; clear, smooth boundary.
A2	8 - 32"	Light grey to white (10YR 6/1 - 8/1) medium sand; single grain structure; loose; occasional fine roots; extremely acid; abrupt, smooth boundary.
B1h	32 - 35"	Dark reddish brown sand compact in place but breaks out into a loose mass of fragments of various sizes depending upon pressure exerted on the soil mass; no roots observed; extremely acid; clear, smooth boundary.
B2h	35 - 42"	Dark brown to very dark greyish brown (10YR 3/3 - 3/2) sand, compact in place but somewhat less than the horizon above; breaks into a loose mass; no roots observed; extremely acid; gradual, smooth boundary.
C	42"+	Light grey (10YR 7/1) medium sand; single grain structure; loose; extremely acid.

Type Location: The representative profile was described and sampled 3 miles south of the Torani Canal, and east of Fort Nassau, near the Berbice River.

Range in Characteristics: Colour of the surface soil ranges from very dark grey to very light grey. Depth to the pan (cemented layer) ranges from 15 to more than 36 inches. The pan is compact and slowly or very slowly permeable, and in many places is hard.

Competing Series and their Differentiae: The dark coloured, cemented pan layer distinguishes soils of the Ituni series from the other light coloured sandy soils. Ituni soils are generally in wet places.

Setting: Ituni soils are in nearly level or very gently sloping, wet places in areas of white sand. The substratum consists of beds of white or brown sand, loam or clay.

Principal Associated Soils: Tiwiwid soils (700) or Tabela soils (800) are in adjacent, excessively drained or well drained places. Henrietta or Siparuta soils are along small streams or in depressions.

Drainage and Permeability: Ituni soils are poorly drained. The cemented pan layer is slowly or very slowly permeable.

Vegetation and Use: Vegetation is forest or sparse savannah. The soils are acid, saturated with water most of the year, and almost devoid of plant nutrients. They should not be considered for ordinary cultivation. Capability subclass IVw.

Distribution and Extent: Ituni soils are scattered throughout the area of white sand.

Series Established: Soil Survey, Canje Area, 1963.

Remarks: The soils are interesting because of the prominent, organic-cemented pan layer, called a spodic horizon in the new soil classification of the U.S. Soil Survey.

Source: Soil Survey, Canje Area, preliminary release, 1964. Compiled in this form by J. G. Steele, December, 1965.

Jacaré Series

In the Jacaré series are soils classified as Typic Quartzipsamments, members of a deep, isothermic family (Regosols, excessively drained). They are rolling, deep, light coloured medium sands.

Typical Profile of Jacaré Sand, on a watershed of low rise:

0 - 6"	(10YR 4/3); dark greyish brown medium sand; loose; common grass roots.
6 - 16"	(10YR 5/3); brown medium sand; loose; few roots.
16 - 72"	(10YR 6/4); light yellowish brown sand to slightly loamy sand; slightly coherent; very few roots.

Type Location: Near Jacaré at the western end of the Kamku Mountains.

Range in Characteristics: Not known in 1965.

Competing Series and their Differentiae: Apparently more brown than Tiwiwid sand. Differentiae from the Tabela soils need to be established, or the soils should be correlated with that series.

Setting: "On a peculiar type of relief consisting of rolling, deep, light coloured medium sands associated with frequent water holes and large ponds".

Principal Associated Soils: Emprensa and Makushi soils on less sandy colluvial slopes; Ambrose soils on some slopes that are less well drained; alluvial soils lie down slope. Less well drained soils are in the water holes and ponds.

Drainage and Permeability: Described by Loxton and others (1958) as moderately well drained. Apparently, however, they were referring to the entire association, of well drained Jacaré soils on the rolling slopes and adjacent somewhat poorly or poorly drained soils in the included water holes and ponds.

"The incidence of water holes in the terrain implies some drainage impedance at certain sites but there was no indication of this in the profile examined. Texturally very sandy, the porosity of the profile is indicated by the presence of grass roots which have penetrated to great depth." These observations indicate rapid permeability.

Vegetation and Use: Vegetation at the sampling site was described as Trachypogen plumosus (velvet grass variant) and Curatella americana savannah grasses and shrubs; curatella trees are sparse and the grass cover is strongly tufted. "The area cannot be considered agriculturally very promising."

Distribution and Extent: About 10 square miles in the Rupununi soil survey (published 1958); further extent not known in 1965.

Series Established: Soil survey of Rupununi Savannahs, published 1958.

Remarks: The need of differentiae this series from the Tabela series should be investigated.

Source: Taken from Soil and Land Use Survey No.2., Rupununi Savannahs. Regional Research Centre at I.C.T.A., Trinidad, March 1958. Arranged in this form by J. G. Steele, November, 1965.

Kamani Series, 53

In the Kamani series are soils classified as Aquic Fragiudults, members of a fine silty family. (Planosol with fragipan, poorly drained). Typically they have a grey or dark grey silty surface soil over a light grey or grey, dense, silty horizon that is brittle but notcemented or rocklike.

Typical Profile of Kamani silt.

A1	0 - 5"	Grey (10YR 6/1) silt loam; weak, fine, granular structure; slightly sticky, slightly plastic; few fine mottles; numerous fine and medium roots; extremely acid; clear, smooth boundary.
A3	5 - 9"	Light grey (5Y 7/1) silt loam; weak, fine granular structure; slightly sticky, slightly plastic; numerous fine and medium roots; common, large roots; some penetration of A1 material; extremely acid; clear, smooth boundary.
B1	9 - 15"	Light grey (5Y 7/1) silt loam; weak, medium subangular blocky structure; firm; slightly sticky, non plastic; common, medium and fine roots, worm holes and earthworms present; some penetration of A1 material; extremely acid; abrupt, smooth boundary.
B1x	15 - 19"	Light grey (5Y 7/1) silt, with few, fine and prominent yellowish red mottles mainly along root channels; compact in place; massive structure; non sticky; non plastic; occasional fine roots; extremely acid; clear, smooth boundary.
B2x	19 - 31"	Grey (10YR 6/1) silt loam with common, medium and prominent brownish yellow and yellowish red, and few, fine distinct light grey mottles; compact in place; massive; slightly sticky; slightly plastic; few fine and medium roots; extremely acid; clear, wavy boundary.
C1g	31 - 41"	Grey (10YR 6/1) silt loam to silty clay loam with common, medium, prominent yellowish red, dark red and yellowish brown mottles; weak, coarse angular blocky structure; slightly sticky, slightly plastic; few clay flows on vertical faces; extremely acid; clear, smooth boundary.
C2g	41 - 56"+	Grey (5Y 6/1) clay with many, large prominent dark red and some brownish yellow mottles; some red mottles are the beginning of concretions; weak, coarse angular blocky structure, clay flows on vertical faces of cracks; slightly sticky and plastic; extremely acid.

Type Location: About 3/4 mile north of Torani Canal and about 6 miles east of the Berbice River, British Guiana.

Range in Characteristics: Thickness of the silt pan ranges from 4 to 24". Consistence of the pan is firm or extremely firm when moist.

Competing Series and their Differentiae: The dense silt pan distinguishes Kamani soils from the other poorly drained silty soils. They are better drained and have lighter coloured surface soil than Vigilante soils (54). They are more poorly drained and have more grey in the subsoil than the Helvetia (52), Nassau (57) or Dageraad (58) soils.

Setting: Kamani soils are on toe slopes, and on low flats bordering drainageways, mainly in savannahs, on the old silty alluvial terraces known as the Coropina Formation.

Principal Associated Soils: Associated with Vigilante soils (54) which are dark-coloured soils in wet places; with Helvetia soils (52) which lack of fragipan; and with the better drained Nassau (57) and Dageraad soils (58).

Drainage and Permeability: Kamani soils are poorly drained, as shown by the light grey subsurface soil and the mottled subsoil. Surface drainage is slow. Permeability is slow or very slow in the fragipan.

Vegetation and Use: Natural vegetation is savannah. Some improvement of pasture might be effective, but the soil is poorly suited for cultivation. Drainage would be difficult and even if the soil could be drained it would still have characteristics unfavourable for production of crops. The subsoil would tend to remain wet and the surface soil packs easily. Capability subclass IIIm.

Distribution and Extent: Located on toe slopes and on low flats bordering drainageways, on old silty terraces known as the Coropina Formation, near the inner margin of the coastal plain and not far from the more sloping, sandy soils. Located in North-eastern British Guiana. The total extent is only a few thousand acres.

Series Established: Canje area, British Guiana, 1963.

Remarks: None

Sources: Soil Survey, Canje Area, British Guiana by Robert Brinkman, 1964. Arranged in this form by J. G. Steele, July, 1965.

Kangaruma Series

The name Kangaruma was applied to an undifferentiated group of alluvial soils in the soil survey of the Mahdia Valley, published in 1959. The map, however, shows a mapping unit of undifferentiated alluvial soils, and the name Kangaruma does not appear in the map legend.

It is suggested in 1966 that use of the name should be delayed until further studies of alluvial soils in the interior have been made. If definite series of soils need to be defined, the name Kangaruma can be given to one of them.

Kaput Series

Soils of the Kaput series are classified as Typic Udorthox, members of a deep, clayey family; and as Red-Yellow Latosols, well drained. They have a sandy clay surface soil and reddish yellow clay loam or clay subsoil. Cemented ironstone gravel is present in some places.

Typical Profile of Kaput Clay:

0 - 9"	(10YR 3/2); very dark greyish brown; structureless; sandy clay; common roots.
0 - 17"	(10YR 5/4); yellowish brown clay loam; structureless; few roots.
17 - 59"	(7.5YR 6/6); reddish yellow clay loam; structureless; few roots.
59 - 74"+	(2.5Y 7/4); pale yellow clay; structureless to very weak fine subangular blocky structure; common soft and hard Fe concretions; few roots.

Type Location: Near headwaters of Sawariwau River in the Rupununi Savannahs, south-western British Guiana.

Range in Characteristics: There is a loss of red colour down slope. The upper part of the ironstone gravel in most places is poorly cemented and readily broken.

Competing Series and their Differentiae: Kaput soils are a southern counterpart of the Lethem soils. Both series should be re-examined to see if they should be correlated as one.

Setting: Kaput soils occupy crests and slopes of a large part of the rolling terrain. In many places they formed around outcrops of country rock. Cemented ironstone gravel is present in many places.

Principal Associated Soils: Sawariwau soils are on slopes and ridge tops that have a "pavement" of quartz and magnetite gravel and boulders but little or no ironstone. Waruna soils are poorly drained associates in the small bottoms between slopes.

Drainage and Permeability: Well drained, probably moderately permeable.

Vegetation and Use: Native vegetation is savannah grasses and shrubs. The soils are used for grazing. They are highly leached, are compacted easily by rain, and are very subject to sheetwash. They dry out deeply in the dry season.

Distribution and Extent: The Kaput Waruma Association occupies 136 square miles in the area covered by soil surveys: Kaput soils make up about 60 percent or 82 square miles. The soils probably extend further to the east and south.

Series Established: Soil Survey of the Rupununi Savannah, published 1958.

Remarks: Classification has been estimated from the published description. Characteristics need to be observed again in the field and the possibility of correlation with the Lethem series should be investigated.

Source: Soil and Land Use Surveys No.2., British Guiana, The Rupununi Savannahs. Regional Research Centre at I.C.T.A., Trinidad, March, 1958.

Karanambo Series

Karanambo soils are members of a sandy over clay, isothermal family of Aquic Haplorthents. They are also classified as Low Humic Gley soils, poorly drained. They consist of grey loamy sand, darkened at the surface, over light grey sandy clay loam underlain by light yellowish brown fine sandy clay.

Typifying Pedon: Profile of Karanambo loamy sand.

0 - 2"	(10YR 3/1); very dark grey, highly humic loamy sand; loose, structureless, many roots.
2 - 12"	(10YR 5/1); grey loamy sand; loose structureless.
12 - 30"	(10YR 7/2); light grey, sandy clay loam; structureless; common, diffuse orange mottling especially along root channels.
30 - 72"	(10YR 6/4); light yellowish-brown, fine sandy clay containing small quartzitic boulders and gravels.

Type Location: Near Karanambo just west of the Rupununi River in south western British Guiana.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: This soil occupies a position similar to that of the Burru soils, but has been formed in old creek deposits covered with colluvial material from Lethem soils.

Setting: The Karanambo soils were not mapped separately, but were described as inclusions in areas of the Lethem-Burru Association. They are in low places between areas of Lethem soils, apparently in old creek channels that have been covered with colluvial material from Lethem soils.

Principal Associated Soils: Lethem soils are on slopes. Burru soils are in similar low places that do not have the colluvial overwash.

Drainage and Permeability: Probably poorly drained and slowly permeable.

Vegetation and Use: Vegetation is mostly sedges and swamp grasses. Used for grazing and best suited for that use in view of the seasonal flooding and rapid drying out.

Distribution and Extent: Occupies small areas in the Lethem-Burru association of soils mapped near Karanambo and Kwainatta in the northern Rupununi Savannahs, south-western British Guiana. Further distribution and extent are not known in 1965.

Series Established: Soil survey of the Rupununi Savannahs (continued), published in 1959.

Remarks: The extent and the range of characteristics should be further studied to determine whether the series should be maintained or dropped.

Source: This description and accompanying notes were taken from Soil and Land Use Surveys No.6 British Guiana, Regional Research Centre at I.C.T.A., Trinidad, June, 1959. Arranged in this form by J. G. Steele, October, 1965.

Kariakuri Series 221

The Kariakuri series was established in the Soil Survey of the Mahaica-Mahaicony-Abary Area, and named in the report that was released in preliminary form in February, 1965.

The soil described resembles Mara clay except for a layer of grey or light grey silt 2 - 5 inches thick at the top of the mineral soil. Since only 250 acres were mapped, it is recommended that the soil be correlated as a silty overwashed phase of Mara clay, and that the name Kariakuri can be dropped from the list of soil series.

J.G. Steele,
November, 1965.

Kasarama Series 810

Soils of the Kasarama series are classified as members of a sandy, siliceous family of Psammentic Udorthox; also as Red-Yellow Latosols, well drained. The surface soil is brown to dark greyish brown sand or loamy sand. The subsoil is strong brown to light yellowish brown or yellowish red sandy loam to sandy clay loam.

Typifying Pedon: Representative profile of Kasarama loamy sand.

A1	0 - 10"	Dark greyish brown (10YR 4/2) loamy sand; weak fine granular structure; very friable; vesicular pores common; fine roots common; few medium to coarse sand grains; insect casts common; extremely acid; gradual, smooth boundary.
A3	10 - 16"	Brown (10YR 5/3) loamy sand; weak, fine granular structure; very friable; fine vesicular pores common; fine roots common; few insect casts; extremely acid; clear, wavy boundary.
B1	16 - 22"	Strong brown (7.5YR 5/6) light sandy loam; some penetration of A3 material; weak, coarse granular structure; fine vesicular pores common; few coarse sand grains; very friable; old root channels containing darker material are common; extremely acid; clear, smooth boundary.
B12	22 - 34"	Strong brown (7.5YR 5/6) sandy loam; very weak, fine blocky to coarse granular structure; very friable; vesicular pores common; coarse sand grains common; extremely acid; gradual, smooth boundary.
B22	34 - 62"	Yellowish red (5YR 5/8) sandy loam; very weak blocky breaking into weak medium granular structure; friable; vesicular pores common; coarse sand grains common; occasional root; extremely acid; gradual, smooth boundary.
CI	62 - 76"	Yellowish red (5YR 5/6) sandy loam; massive; friable; coarse sand grains common; extremely acid; gradual, smooth boundary.
C2	76"+	Yellowish red (5YR 5/8) sandy clay loam; massive, friable; extremely acid.

Type Location: One mile southeast of Ebini Livestock Station.

Range in Characteristics: Colour of the surface soil ranges from brown or dark greyish brown to pale brown; texture is loamy sand or sandy loam. Colour of the subsoil ranges from strong brown to yellowish red or light yellowish brown, and texture from sandy loam to sandy clay loam. The lower subsoil and substratum in some places contain few to common strong brown or red concretionary mottles, and few to common laterite pebbles.

Competing Series and their Differentiae: Kasarama soils contain more clay than Tabela soils and less clay than Ebini soils. Kasarama soils have subsoil that is sandy loam to sandy clay loam; Tabela soils have subsoil that is sand or loamy sand; and Ebini soils, sandy clay or clay. Kasarama soils lack the very dark grey surface soil and the grey subsoil that are characteristic of the less well drained Mibirikuru soils (740).

Setting: Kasarama soils are on gently sloping sandy plains of the Berbice geological formation. The topography is everywhere undulating, and there are many depressions, without outlets, that are occupied by more poorly drained soils. Slopes in most places are less than 3 percent, but in some places are more. Anthills, most of them abandoned, are common, especially in the savannah; and are more numerous than on the Tabela soils.

Principal Associated Soils: Tabela soils (800) and Ebini soils (820) occupy similar locations, and the kind of soil has to be determined by boring to learn the texture. Mibirikuru soils (740), Wairuni soils (742), Henrietta soils (730), or Siparuta soils (732) are in adjacent low places.

Drainage and Permeability: Well drained; probably rapidly permeable.

Vegetation and Use: Native vegetation is partly savannah dominated by coarse bunch grasses of low nutritive quality, and partly forest. The soils are extremely acid and extremely low in all the plant nutrients. They are easily worked; with lime and fertilizer many crops can be grown, among them peanuts, tomatoes, pineapples, vegetables and ground provisions. Irrigation is desirable for annual crops; the chances of successful crops under natural rainfall need to be determined. The soils are well suited for orchard crops and well or moderately well suited for improved pastures. Control of runoff to prevent erosion is essential, even on slopes of 2 or 3 percent. Capability subclass (A slope only), IIf.

Distribution and Extent: Kasarama soils are extensive in the gently sloping sandy plains of the northeastern part of British Guiana. They make up more than one-fourth of the land in the semi-detailed soils survey of the Ebini-Ituni-Kwakwani Area, and nearly 40 percent of the sandy land in that survey.

Series Established: Soil Survey of the Intermediate Savannahs, published June, 1959. Redefined by Brinkman, Soil Survey, Ebini-Ituni-Kwakwani Area 1964.

Remarks: The Takama series (710) was described by Brinkman as slightly lighter coloured, but otherwise like the Kasarama series. The Takama series was combined with the Kasarama series in 1965.

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary release, May, 1964. Compiled in this form by I.G. Steele, December, 1965.

Kerkenama Series, 32

Soils of the Kerkenama series are classified as members of a clayey, slowly permeable family of Typic Umbraquults; also as Humic Gley soils, very poorly drained. They have a surface layer of black or very dark grey clay, more than 7 inches thick; and a subsoil of grey, very firm mottled clay. The substratum is grey or greenish grey, mottled, firm clay. In some places there is a thin layer of peat on the surface.

Typifying Pedon: Representative profile of Kerkenama clay.

O1	3 - 0"	Manicole leaf litter and residues.
A1	0 - 8"	Very dark grey (10YR 3/1) clay; medium fine granular structure; friable; slightly plastic and sticky; numerous fine roots, occasional medium roots; extremely acid; gradual, smooth boundary.
A2	8 - 14"	Grey (10YR 5/1) clay; medium coarse granular structure; firm; plastic and sticky; bits of darker clay from above penetrating to 18 inches; occasional fine roots; extremely acid; clear, smooth boundary.
B1	14 - 21"	Grey (5Y 6/1) clay with few,medium, prominent brownish yellow and yellowish brown mottles; massive; very firm; plastic and sticky; extremely acid; clear, smooth boundary.
B2	21 - 38"	Grey (5Y 5/1) clay, with many, medium, prominent brownish yellow and yellowish brown mottles; weak medium subangular blocky structure; very firm; plastic and sticky; extremely acid; gradual, smooth boundary.
B3g	38 - 52"	Grey (5Y 5/1) clay with common, medium, prominent brownish yellow mottles; occasional brown concretions; massive; very firm; plastic and sticky; extremely acid; clear, smooth boundary.
C1g	52 - 60"	Grey to greenish grey (5Y 5/1 - 5GY 6/1) clay with common, medium, prominent brownish yellow mottles; common, strong brown and dark brown concretions; massive structure; very firm, plastic and sticky extremely acid.

Type Location: The representative profile was described and sampled about 3 miles East of the Berbice River and 7 miles South of Mara in Berbice County.

Range in Characteristics: Colour of the upper A horizon is black or very dark grey; that of the B horizon ranges from greenish grey to light brownish grey. Mottling in the B horizon and C horizon ranges from brownish yellow to dark red. A thin cover of peat is on the surface in some places.

Competing Series and their Differentiae: Kerkenama soils are more poorly drained and have darker coloured surface soil than Canje (31) or Vryberg (34) soils. They are less friable than Black Bush soils (3) and their B horizon is more acid and has stronger structure than the subsoil of Black Bush soils. They have denser and apparently less permeable subsoil, and much more acid subsoil and substratum, than Brandwagt soils.

Setting: Kerkenama soils developed in fine textured alluvium, in depressions within the old natural levees along streams in the coastal area. The substratum is acid, very firm clay.

Principal Associated Soils: Kerkenama soils are associated with and in some places are within areas of Canje (31), Everton (31a), Vryberg (34) or Bath (34a) soils. Some areas lie next to Mara clay or its peaty phase (21 or 22).

Drainage and Permeability: Very poorly drained; probably slowly permeable.

Vegetation and Use: Native vegetation is mostly water-tolerant forest or wet savannah. The soils are very strongly acid, low in calcium, potassium and phosphorus, slowly permeable, and difficult to drain. The dense subsoil limits their suitability for crops. With drainage, lime and complete fertilizer they are moderately suited for rice, sugar cane, bananas, pasture and some other crops. Capability subclass IIm.

Distribution and Extent: Extent in the areas covered by semi-detailed soil surveys (1965) is about 40 square miles.

Series Established: Mahaica-Mahaicony-Abary Area, 1962.

Remarks: None

Source: Soil Surveys, Mahaica-Mahaicony-Abary Area and Canje Area, preliminary releases, 1964. Compiled in this form by J. G. Steele, November, 1965.

Kuma Series

Soils in the Kuma series are classified as Typic Udorthox, members of a deep, clayey family, and also as Red-Yellow Latosols, moderately well drained. They consist of a surface layer of brown sandy clay over yellowish brown clay. Horizons are not distinct.

Typical Profile of Kuma Sandy Clay

0 - 5"	(10YR 5/3); brown sandy clay; structureless; roots common.
5 - 14"	(10YR 5/6); yellowish brown clay; structureless; rare small Mn and Fe concretions; roots common.
14 - 26"	(10YR 5/6); yellowish brown clay; friable; rare small Mn and Fe concretions; few roots.
26 - 69"	(10YR 5/6); yellowish brown clay; structureless; common large soft Mn concretions; rare hard Fe concretions; few roots.

Type Location: Near Moko-Moko Village, southeast of St. Ignatius in the Rupununi Savannahs of southwestern British Guiana.

Range in Characteristics: To be determined. Not stated precisely in the published description of 1958.

Competing Series and their Differentiae: Kuma soils lack the outcrops and boulders of ironstone that are characteristic of the St. Ignatius soils and to some extent of the Lethem soils.

Setting: Kuma soils are on gentle colluvial slopes, near undulating uplands on which there are soils of the St. Ignatius or the Lethem series. The parent material apparently was ironstone similar to that in the St. Ignatius soils.

Principal Associated Soils: St. Ignatius and Lethem soils are on undulating uplands. Alluvial soils are on adjacent flood plains.

Drainage and Permeability: Described as moderate well drained; but since no mottling is described in the typical profile, it is assumed that the soils might be well drained according to definitions in the soil survey Manual. Permeability is estimated to be moderate.

Vegetation and Use: Native vegetation consists of savannah grasses and shrubs. Used mainly for grazing. The soil surveyors reported that good citrus was seen, and that tobacco was grown after a period of coralling.

Distribution and Extent: The extent is about 11 square miles in the area covered by soil surveys. Further extent is not known in 1965.

Series established: Soil survey of the Rupununi Savannahs, published 1958.

Remarks: The possibility of correlation with Lethem soils in one series should be investigated.

Source: Named and description in soil and land use surveys No.2., British Guiana the Rupununi Savannahs. Regional Research Centre at I.C.T.A., Trinidad, W.1. March 1958. Compiled in this form by J. G. Steele, November, 1965.

Kwainatta Series

Kwainatta soils are members of a deep, acid family of Typic Quartzipamments. They are also classified as Regosols, excessively drained. They consist of deep sand, possibly old beach deposits of a former lake.

Typifying Pedon: Profile of Kwainatta sand.

0 - 4"	(10YR 5/2); grey-brown medium sand; structureless; common roots.
4 - 37"	(10YR 6/3); pale brown loamy sand; loose, structureless; common roots.
37 - 72"	(10YR 7/3); very pale brown sandy loam with a fine brick-red mottle.

Type Location: Near Kwainatta Village in Northern Rupununi Savannahs, South-western British Guiana.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: The author of Report No. 6 suggested possible correlation with Jacaré soils. Possible correlation of both series with the Tabela series (800) should also be investigated, and differentiae established if more than one series is to be retained.

Setting: The soils are on flat-topped sandy hills skirting the lateritic upland area of this section, and have formed on the remnants of old terrace deposits. Possibly these hills are old beach deposits of a former lake. The hills usually occur alongside and are elongated in a similar direction to water holes or creeks.

Principal Associated Soils: Associated chiefly with Lethem, Rupununi, and Benoni soils.

Drainage and Permeability: Excessively drained, very rapidly permeable.

Vegetation and Use: Native vegetation is sparse, tufted grass, mostly Trachypogon plumosus, and some trees, Curatella americana. Very little grazing is afforded. Villages and settlements are often located on these soils because the soil is dry even at the height of the wet season.

Distribution and Extent: Soils of this series occupy 7 square miles in the Northern savannahs near the Rupununi River. Further extent is not known.

Series Established: Soil survey of the Rupununi Savannahs (continued), published 1959.

Remarks: Soils of this series should be examined, and soils of the Jacaré series also, for possible correlation with each other and with the Tabela series.

Source: Compiled from soil and Land Use Surveys No.6, British Guiana, Regional Research Centre at I.C.T.A., Trinidad, June 1965. Arranged in this form by J. G. Steele, November, 1965.

Lama Series. 60

Soils of the Lama series are organic soils, classified as Histosols in the new classification and as Bog soils in the great soil groups of 1938. They consist of 8 to 18 inches of black, well decomposed muck over dark reddish brown peat. The substratum below 36 inches can be peat, soft greenish grey clay, silty sediments or sandy sediments.

Typifying Pedon: Representative profile of Lama muck.

01	0 - 12"	Black (5YR 2/1) muck; extremely acid; clear boundary.
021	12 - 18"	Black (N 2/1) mixture of ash, charred organic remains, and peaty muck; extremely acid; clear boundary.
022	18 - 30"	Dark reddish brown (5YR 2/2) peat; extremely acid; diffuse boundary.
023	30 - 42"	Dark reddish brown (5YR 2/2) peat; extremely acid; gradual boundary.
024	42 - 54"	Dark reddish brown (5YR 2/2) peat; extremely acid.

Type Location: The representative profile was described and sampled about 1 mile north east of Ikuruwa Lake, near the Corentyne River in Northeastern British Guiana.

Range in Characteristics: The muck ranges from 8 to 18 inches in thickness. Thin horizons of acid clay are in the profile at some places. The substratum is clay where the muck is associated with soils of the Coropina geological formation, and sand where associated with sandy soils on the Berbice formation. If the substratum is clay, it is likely to contain acid sulphates.

Competing Series and their Differentiae: Lama muck is darker coloured and retains less structure of the original plant material, in the upper 8 to 18 inches, than Arnia peat (20).

Setting: Loam muck lies in depressions in soils of the silty Coropina geological formation, and in low places or along streams that flow from the higher land into swamps.

Principal Associated Soils: Lama muck in most places lies next to soils that range from gently sloping to steep. They are chiefly the silty soils on the Coropina geological formation, sandy soils on the Berbice formation, and sandy soils of the uplands that are underlain by weathered igneous rocks.

Drainage and Permeability: Very poorly drained; saturated unless artificially drained. Permeability is variable.

Vegetation and Use: Vegetation is swamp forest. The soils are not well suited for cultivation, especially if toxic sulphates are present; but some successful farms are operated. The muck is likely to shrink greatly if it is drained, and control of water then is difficult. Fire is a serious hazard after drainage, and the burned residue is likely to contain toxic aluminium. If soil containing acid sulphates is drained and well aerated, it becomes extremely acid and toxic for many plants. Over-drainage therefore must be avoided. With careful control of water and a high level of management, some crops can be grown; among them ground provisions, coffee, pineapples, corn and many vegetables. Capability subclass IIIm, after drainage.

Distribution and Extent: Lama muck occurs along rivers and streams near the inside margin of the coastal plain; and along small streams that lie at or just above the level of water in the coastal swamps. About 30 square miles were mapped on the semi-detailed soil surveys of 1961-64. The area remaining to be mapped, along streams in and near the coastal swamps, probably is several times larger.

Series Established: Soil Survey, Mahaica-Mahaicony-Abary Area, 1962.

Remarks: Classification in the new system, within the order of Histosols, should be completed after criteria for the suborders, groups, and subgroups have been established.

Sources: Soil Surveys of Canje Area, Mahaica-Mahaicony-Abary Area, and Ebini-Ituni-Kwakwani Area, released in preliminary form, 1964; also soil surveys in 1963 and 1964 by H. N. Ramdin and others in British Guiana. Compiled in this form by J. G. Steele, March, 1966.

Lethem Series

In the Lethem series are soils classified as Typic Udorthox, members of a deep, clayey family (Red-Yellow Latosols, well drained). They consist of sandy clay to gravelly clay loam at least 3 feet deep, over ironstone or concretionary ironstone gravel.

Typical Profile of Lethem: Sandy clay loam.

0 - 3"	(10YR 5/4); yellowish brown sandy clay loam; soft; rare small Mn and Fe concretions; weak, very fine crumb structure.
3 - 18"	(5YR 5/8); yellowish red fine sandy clay; common small Mn and Fe concretions; structureless; few roots.
18 - 46"	(5YR 5/8) yellowish red silty clay; common small Mn and Fe concretions; structureless; few roots.
46 - 74"	(5YR 5/8) yellowish red silty clay; common small Mn and Fe concretions; friable.

Type Location: South of Lethem in the Rupununi Savannahs, southwestern British Guiana.

Range in Characteristics: The depth of gravel or ironstone is at least 3 feet. Ranges in characteristics need to be described.

Competing Series and their Differentiae: St. Ignatius soils consist of ironstone gravel, or have gravel or solid ironstone within 3 feet of the surface.

Setting: Lethem soils apparently were formed from parent material weathered from the ironstone detritus that makes up the St. Ignatius soils. These soils occupy slopes between the lateritic hills, with Burru soils on bottom of the slopes.

Principal Associated Soils: St. Ignatius soils where the ironstone has not been weathered to sandy clay; Burru soils on lower slopes.

Drainage and Permeability: Well drained; probably moderately permeable.

Vegetation and Use: Native vegetation is savannah grasses and shrubs. The surface soil is subject to compaction and then erosion takes place readily.

Distribution and Extent: Are association of Lethem and Burru soils occupies 66 square miles in the parts of the savannahs covered by soil surveys.

Series Established: Soil survey of Rupununi Savannahs, published 1958.

Remarks: Classification has been estimated on the basis of the published description. The series needs to be described more precisely.

Source: Soil and Land Use Survey No. 2., Rupununi Savannahs, Regional Research Centre at I.C.T.A., Trinidad, March, 1958. Arranged in this form by J. G. Steele, October, 1965.

Lichfield Series, 42

Soils of the Lichfield series are classified as members of a clayey family of Umbric Ochraqualfs; also as Humic Gley soils, very poorly drained. They have a thick, very dark grey surface soil, a brownish yellow, mottled clay subsoil, and a greenish grey, mottled clay substratum.

Typifying Pedon: Representative profile of Lichfield clay.

A1	0 - 11"	Very dark grey (10YR 3/1) clay mottled with yellowish red; mottles are common, fine and distinct and occur mainly along root channels; coarse and medium subangular blocky structure; firm; slightly sticky, slightly plastic; many fine fibrous roots; very strongly acid; clear, smooth boundary.
B22	11 - 18"	Brownish yellow (10YR 6/6) clay mottled with grey; some very dark grey occurs in cracks; mottled are common, medium and prominent; medium subangular blocky structure; firm; sticky, plastic; few fine roots; strongly acid; gradual, wavy boundary.
B23g	18 - 25"	Grey (5Y 6/1) clay mottled with brownish yellow; mottles are common; medium and prominent; medium subangular blocky structure; firm, sticky, plastic; few fine roots; neutral; clear, smooth boundary.
B3g	25 - 48"	Greenish grey (5GY 6/1) clay mottled with yellowish brown; mottles are common, medium and prominent; fine subangular blocky structure; firm; sticky, plastic; occasional fine roots; mildy alkaline; gradual, wavy boundary.
Cg	48"+	Greenish grey (5GY 6/1) silty clay mottled with yellowish brown; mottles are common, medium and prominent; massive structure; firm, sticky, plastic; occasional fine roots; mildly alkaline.

Type Location: The representative profile was described and sampled at Burma, East Coast Demerara, 2 miles south of the railroad and three-fourths mile East of Burma Road.

Range in Characteristics: Colour of the surface soil is black or very dark grey, and texture is clay or silty clay. Some soft concretions and also some lenses of silt are present at some places in the substratum. Reaction of the B horizon ranges from pH 5.0 in the upper part of pH 7.2 in the lower part. A sandy substratum phase, located mostly near the sandy ridges, has a substratum of greyish brown neutral or alkaline sand below 30 to 48 inches.

Competing Series and their Differentiae: Lichfield soils are more poorly drained than Buxton soils (45) and the surface horizon contains more organic matter. The subsoil is more brownish yellow than that of Black Bush soils (3), and more permeable than that of the Brandwagt soils (32a).

Setting: Lichfield soils developed in marine clays within the area known as frontland clay. The substratum is firm clay to a depth of 48 inches or more.

Principal Associated Soils: Associated with soils of the Onverwagt (41), Rosignol (43) and Buxton (45) series; the sandy substratum phase as a rule adjoins soils of the Ithaca (72) or the Novar (70) series.

Drainage and Permeability: Very poorly drained; probably slowly or moderately permeable.

Vegetation and Use: Native vegetation is wet savannah or water tolerant trees. The soils are very strongly acid in the surface layer and as a rule are low in phosphorus and potassium. They are easy to drain and till. With drainage, lime, and fertilizer they are well or moderately well suited for most of the common crops. Capability subclass Im. The sandy substratum phase contains salts but is moderately permeable and can be drained and reclaimed with moderate difficulty. Until salts have been leached, it is in capability subclass IIs.

Distribution and Extent: About 11 square miles were mapped in the Mahaica-Mahaicony-Abary Area. Further extent in areas not yet covered by soil surveys is probably not much greater.

Series Established: Mahaica-Mahaicony-Abary Area, 1962.

Remarks: After salts have been leached, flooding with brackish water should be prevented.

Source: Soil Survey, Mahaica-Mahaicony-Abary Area, preliminary release, February, 1964. Compiled in this form by J. G. Steele, November, 1965.

Long Man Swamp Series

Long Man Swamp soils are members of a clayey, isothermal family of Typic Ochraquults. They are also classified as Low Humic Gley soils, poorly drained. The soil consists of dark brown, greyish brown or brownish yellow clay, faintly mottled in the upper horizon and may have an overwashed layer of sand on the surface.

Typifying Pedon: Profile of Long Man Swamp clay with sandy overwash.

0 - 5"	(2.5Y 6/2) light brownish grey loamy fine sand; structureless; soft; many roots.
5 - 16"	(2.5Y 4/2) dark grey brown clay; extremely hard; angular blocky structure; common small Fe concretions; very faint disperse yellow mottling; few roots.
16 - 40"	(2.5Y 5/2) greyish brown clay; hard, angular blocky structure; common small Fe concretions; faint disperse mottling.
40 - 68"	(10YR 6/6) brownish yellow dispersed mottled clay; common Fe concretions and common grey sandy veins.

Type Location: Near Wichabai west of the Rupununi River in Southwestern British Guiana.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: These soils are less wet and the surface layer is less humic than those of the Dead Man Swamp series. Suggett described a Low Humic Gley soil, sandy phase, that will need to be distinguished from these clay soils, and given a series name if extensive enough.

Setting: Swamps, in depressions and low flats that are intermittently flooded.

Principal Associated Soils: Higher and more sloping soils of the Sawariwau, Wichabai, or Ambrose series adjoin many of the areas.

Drainage and Permeability: Poorly drained and slowly permeable. Flooded intermittently for a total of several months each year. The clay subsoil leads to a continuation of wet season conditions long into the dry season.

Vegetation and Use: Vegetation of the site described was mainly grasses of Paspalum species. Grass growth was good. The soil described and sampled was neutral below 5 inches, but Suggett's description of a Low Humic Gley soil suggests that the usual soil of that great group in this vicinity is acid. If these wet soils of high base status are extensive, they should produce good grazing in the dry season or at least in the early part of it.

Distribution and Extent: About 2½ square miles were mapped on the soil survey of the Rupununi Savannahs. Further extent was not known in 1965.

Series Established: Soil Survey of the Rupununi Savannahs, published 1958.

Remarks: Extent of the neutral or alkaline soil that fits this description will need to be ascertained.

Source: Taken from Soil and Land Use Survey No.2. British Guiana, by Regional Research Centre of I.C.T.A., Trinidad, W.I., March 1958. Arranged in this form by J.G.Steele, 1965.

Macouba Series 30

Soils in the Macouba series are classified as members of clayey, soft, acid, sulphate-containing family of Aquic Haplorthents; and as Low Humic Gley soils, very poorly drained. If undisturbed they have 2 to 12 inches of peat over a thin, soft, dark grey clay surface horizon that is underlain by firm or very firm clay that is grey mottled with red.

Typifying Pedon: Representative profile of Macouba clay.

O1	12 - 0"	Raw peat.
A11	0 - 1"	Black (10YR 3/1) muck and burnt gritty clay.
A12	1 - 4"	Dark grey (10YR 4/1) clay with high organic matter content; plastic, slightly sticky; numerous fine roots; clear boundary.
A2	4 - 11"	Grey (10YR 5/1) clay, plastic, moderately sticky; numerous fine roots; clear boundary.
B1g	11 - 22"	Grey (N6) clay, with common, fine, distinct pa e olive and yellowish red mottles; becoming more numerous with depth; few dark brown soft concretionary materials or root fillings; plastic, moderately sticky, few fine roots; very strongly acid; gradual boundary.
B2g	22 - 36"	Grey (N6) clay with common, medium, prominent yellowish brown, strong brown and dark red mottles and few soft concretionary, yellowish brown and red mottles; increasing downward; concretions tend to follow old root channels; firm; plastic; slightly sticky; few fine living roots; extremely acid; clear boundary.
Cg	36 - 44"	Grey (N6) coarse silty clay loam with large concretionary yellowish brown, strong brown and dark red mottles;thinly laminated structure; firm, moderately plastic; slightly sticky; moderately thin fine sandy loam strata from 40"; medium acid.

Type Location: The representative profile was described and sampled near the Potoco River, about 3 miles west of Brotherson pump in Berbice County.

Range in Characteristics: The peat on the surface ranges from 2 to 12 inches in thickness. The Al horizon is dark grey or black. The subsoil is likely to be slightly to strongly saline, and in many places it contaihs acid sulphates.

Competing Series and their Differentiae: The Macouba soils are more acid and have a much firmer lower subsoil than the Manarabisi soils (211). They are more poorly drained and have darker coloured surface soil than the Skeldon (13) or the Haswell (21) soils.

Setting: Macouba soils are in low, level places where the soil material consists of marine or fluriomarine sediments.

Principal Associated Soils: Manarabisi soils adjoin Macouba soils in many places. Also associated, in slightly higher places, are soils of the Vryberg (34) Vigilante, Cola (152) and Potoco series (157).

Drainage and Permeability: Very poorly drained; probably slowly permeable.

Vegetation and Use: Native vegetation is marsh plants or water-tolerant trees. The soil has moderate or low fertility and is rather difficult to drain. Salts in the subsoil might depress yields of deep rooting crops. With liberal applications of fertilizer such crops as rice, ground provisions, and planted pasture can be grown. Land-capability subclass IIIt.

Distribution and Extent: Macouba soils were mapped on 4810 acres in the Canje Area. Further extent probably is small.

Series Established: Soil Survey of the Canje Area, 1963.

Remarks: None

Source: Soil Survey of the Canje Area, preliminary release, May, 1964. Compiled in this form by J. G. Steele, November, 1965.

Mahdia Series

Mahdia soils, mapped and named in Soil Survey of the Mahdia Valley (1959) appear to have characteristics within the range described for the Durban series, in the Bartica Triangle, published in the same report. Mahdia soils are described as developed over acid rock under the influence of basic rock. Durban soils according to the description, have developed over hybrid granite and hornblende schist type rocks. The soils described under the two names appear to be within limits that can be permitted in one series. The name Mahdia therefore has been dropped, and similar soils will be correlated with the Durban series.

Compiled by J. G. Steele and approved by H. N. Randin, May,1966.

Makushi Series

The Makushi soils are members of a sandy over clay, isothermal family of Arenic Ochraquults. They are also classified as Low Humic Gley soils, poorly drained. They consist of about 20 inches of loamy sand or sandy loam, somewhat darkened by organic matter in the upper 7 inches, over light brownish grey sandy clay that grades to grey clay.

Typifying Pedon: Profile of Makushi loamy sand.

0 - 7"	(10YR 3/1); very dark grey loamy sand; structureless; roots common.
7 - 20"	(10YR 5/2); grey brown sandy loam; structureless; frequent disperse faint yellow mottling; rare distinct red mottling.
20 - 35"	(2.5Y 6/2); light brown grey sandy clay; structureless; rare Fe concretions; faint yellow mottling.
35 - 52"+	(5Y 6/1); grey clay; structureless; rare to common soft Fe concretions; faint yellow mottling.

Type Location: North of the Sawariwau River near the western end of the Kanuka Mountains in Southwestern British Guiana.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: Apparently better drained and contains thicker layers of overwashed sand than the Long Man Swamp soils.

Setting: Makushi soils are in depressions, called baixas, in the areas of very gently to gently rolling slopes that are occupied by Emprensa soils, and on valley flats along drainageways.

Principal Associated Soils: Emprensa soils are on surrounding slightly higher locations.

Drainage and Permeability: Poorly drained, probably slowly permeable. Flooded intermittently during periods of heavy rains. In November the water table was 30 inches from the surface.

Vegetation and Use: Vegetation is mainly sedges. Some Aristida species were growing on the site described. The sandy surface soil and high water table during much of the year produce treacherous conditions for traffic on foot or by vehicle. Because of the high water table, forage plants should respond to fertilizers. The soil is very acid.

Distribution and Extent: Makushi soils occupy perhaps 77 square miles in the area covered by soil surveys, partly in mapping units of the Emprensa-Makushi association. Further extent is not known in 1965.

Series Established: Soil Survey of the Rupununi Savannahs, published 1958.

Remarks: According to the description, these soils occur in areas of soil accumulation between undulating well drained sites. Since the soil is partly the result of sedimentation rather than soil formation, it is suggested that the series can include the soil named in the published report as the Waruma series, which consists of white medium sand over pale olive clay.

<u>Source</u>: Taken from Soil and Land Use Survey No.2., Rupununi Savannahs. Regional Research Centre at I.C.T.A., Trinidad, March 1958. Arranged in this form by J.G. Steele, November, 1965.

Manarabisi Series 211

Soils of the Manarabisi series are classified as members of a clayey, acid, soft or moderately firm family of Aquic Haplorthents. Under a thin layer of peat they have a dark grey to black clay surface soil and a soft, grey or greenish grey clay subsoil that is mottled with yellowish brown, overlying a substratum of firmer soil material.

Typifying Pedon: Typical profile of Manarabisi clay.

O1	4 - 0"	Partly decomposed peat.
A1	0 - 6"	Very dark grey (10YR 3/1) clay; massive structure; soft, slightly sticky, very plastic; part of material slightly gritty giving evidence of burning; few fine roots; very strongly acid; abrupt boundary.
A3g	6 - 18"	Greenish grey (5BG 6/1) clay with few, fine, faint yellowish brown mottles; massive structure; slightly sticky and very plastic; soft; some incorporation of A1 material; medium acid; gradual boundary.
B1g	18 - 36"	Greenish grey (5BG 6/1) clay with common, medium, distinct yellowish brown, olive brown and strong brown mottles; massive structure; soft, sticky, very plastic; slightly acid; gradual boundary.
B2g	36 - 44"	Greenish grey (5BG 6/1) clay with many, medium, prominent yellowish brown, red, strong brown, and olive yellow mottles; massive structure; moderately firm, slightly sticky, moderately plastic; some remains of root cortex; tubular concretions in places; extremely acid; gradual boundary.
Cg	44 - 60"	Greenish grey (5GY 6/1) clay with few, medium, distinct yellow, dark brown and strong mottles; massive structure; moderately firm, slightly sticky, moderately plastic; remains of dead roots, many fine tubular concretions; extremely acid.

Type Location: Described and sampled about 1½ miles west of the Canje River and 5 miles south of Brotherson Pump in Berbice County.

Range in Characteristics: The peat horizon is not present in some places where the soil has been pastured or drained. Thickness of the dark grey or black surface soil ranges from 1 to 6 inches. Depth to the firm substratum ranges from 20 to 42 inches. In some places, but not everywhere, part of the mottling in the lower horizons is red. In a few places the upper subsoil is mottled with brownish yellow and yellowish red.

Competing Series and their Differentiae: The soils are more acid than Corentyne soils; they lack the olive brown mottles, and the substratum is firmer. They lack the very firm red mottled subsoil of Macouba soils. They are more poorly drained and have softer surface soil and subsoil than the Everton, Canje, Vryberg and Bath soils.

Setting: Manarabisi soils consist of level marine or brackish sediments in basins inland from the soils in firmer, alluvial sediments. The substratum is firmer than that of the Corentyne soils.

Principal Associated Soils: Corentyne (11), Mara (21) and Macouba (30) soils are associated in the low places; Everton (31a), Potoco (151), Canje (31), Vryberg (34) and Bath (34a) soils on the adjoining higher land.

Drainage and Permeability: Very poorly drained. According to the soil survey report, the permeability after drainage probably is less than that of the Everton soils (31a) and greater than that of the Canje soils (31).

Vegetation and Use: Native vegetation is wet savannah or swamp forest. Calcium and phosphorus are low, and the content of potassium is variable. The soil is acid. Drainage is essential for all crops. With drainage, lime, and fertilizer, the soil is well suited for rice and moderately suited for sugar cane, ground provisions, bananas, or pasture; but poorly suited for coconuts or peanuts. Land capability subclass IIf.

Distribution and Extent: Manarabisi soils occupy nearly 54,000 acres in the Canje Area. They were not mapped in the Mahaica-Mahaicony-Abary Area.

Series Established: Soil Survey of Canje Area, 1963.

Remarks: None

Source: Compiled from soil survey of Canje Area, released in preliminary form May, 1964. Arranged in this form by J. G. Steele, November, 1965.

Mara Series, 21

The Mara series consists of soils classified in a clayey, sulphate-containing family of Aquic Haplorthents (very poorly drained, Low Humic Gley). Water stands on the surface. The mineral soil is covered with peat up to 12 inches thick. A thin A1 horizon is underlain by grey or greenish grey clay that is soft, almost fluid, and in most places contains acid sulphates.

Typical Profile of Mara clay, 3 miles east of Mara.

01	12 - 3"	Dark reddish brown (5YR 2/2 to 3/2) peat, numerous fine, medium, and large roots; peat is only slightly decomposed and darkens on exposure to air; black muck is common around roots of cedar and other trees, and in many places forms mounds on the mineral soil.
02	3 - 0"	Black (10YR 2/1) muck mixed with yellowish brown (10YR 5/6) burned organic material of ashes, charcoal, and baked clay; strong, fine, subangular blocky structure; slightly brittle but breaks into a black mass; distinct odour of H2S; extremely acid; abrupt, wavy boundary.
A1	0 - 1"	Very dark grey (10YR 3/1) clay; weak medium granular structure; plastic and slightly sticky; numerous fine and medium roots; some penetration of muck from above; clear, wavy boundary.
A21	1 - 4"	Grey (5Y 6/1) with some dark grey in the upper part, clay with yellowish red mottles in root channels; plastic and sticky; faint odour of H2S; extremely acid; clear, smooth boundary.
A22	4 - 12"	Grey (5Y 6/1) clay with many, medium, prominent yellowish red mottles, usually following old root channels; massive structure; plastic and sticky; distinct odour of H2S which disappears after exposure; extremely acid; clear smooth boundary.
B2g	12 - 32"	Greenish grey (5GY 6/1) clay with common medium prominent yellow and yellowish brown mottles; numerous medium and some fine roots; plastic and sticky; few dark brown concretions especially around root channels; distinct odour of H2S; extremely acid; gradual boundary.
B3g	32 - 40"	Grey (10YR 6/1) clay with few, fine; distinct yellowish brown mottles disappearing with depth; massive; plastic and sticky; common fine roots with some brown staining around root channels; distinct odour of H2S; extremely acid; abrupt; smooth boundary.
Cg	40 - 60"	Greenish grey (5G 5/1) clay; plastic and sticky; few fine and medium roots; distinct odour of H2S; extremely acid.

Type Location: About 3 miles east of Mara, east of Berbice River.

Range in Characteristics: The thin horizon of burned clay between the peat and the A1 horizon is present in some but not in all profiles. Thickness of the A1 horizon ranges from 1 to 5 inches. Colour of the subsoil ranges from grey to greenish grey; mottles are few to common and range from dark grey to yellowish brown. The subsoil contains many specks or pieces of organic matter only partly decomposed, and the odour of H2S is faint to distinct throughout.

Competing Series and their Differentiae: If the surface layer of peat is 12 to 30 inches, the soil is classified as Mara Clay, peaty phase. Soils that contain 9 to 18 inches of firm mottled clay over soft greenish grey or grey clay are classified in the Marinero series (101). If the firm clay is 18 to 36 inches deep over the soft greenish grey or grey clay, the soil is classified in the Brickery series (36). Peat more than 30 inches deep is classified as Ahira Peat (20).

Setting: Mara clay has been deposited in low wet places and was at some time subject to constant or repeated flooding by brackish water, and accumulation of organic matter, probably from reeds and mangrove. If organic matter and sedimentary clay were accumulated in the presence of sea water, the resulting clay is likely to contain acid sulphates. In many places Mara Clay or its peaty phase lies next to Anira peat (20).

Principal Associated Soils: Anira peat (20) in swamps Marinero clay (101), Brickery clay (36), Canje clay (31) or other firm clayey or silty soils occur on adjacent, slightly higher land.

Drainage and Permeability: Very poorly drained, very slowly permeable.

Vegetation and Use: Native vegetation is mostly blechnum, fern, moco moco, fine grass, razor grass, wild cherry, white cedar, cork wood, and other water tolerant plants.

The soil is poorly suited for crops. Reclamation is difficult and is not recommended unless the need for land is great. If drained, the soil is extremely low in fertility; if drained enough to bring about aeration and oxidation of the subsoil, an extremely acid, infertile soil is formed. With partial drainage, careful control of water, and adequate management, rice or pasture plants can be grown. Land-capability subclass IIIt.

Distribution and Extent: Chiefly on margins of swamps in the coastal section.

Series Established: Mahaica-Mahaicony-Abary Area, 1963.

Remarks: None.

Sources: Based on descriptions by Robert Brinkman and Clyde C. Applewhite under direction of Glenn H. Robinson, 1964. Assembled by J. G. Steele, May, 1965.

Marabunta Creek Series

In the Marabunta Creek series are soils classified tentatively as Oxic Normudults, members of a clayey family (moderately well or somewhat poorly drained, Red-Yellow Podzolic soils). The surface soil is brownish grey or reddish grey sandy clay to sandy clay loam. The subsoil is yellow to white clay or sandy clay, mottled with brown or yellow. The substratum is yellow or nearly white, clay or sandy clay that retains structure of the schistose rock.

Typical Profile, Mahdia Valley

0 - 14"	(10YR 6/2); light brownish grey, fine gravelly sandy clay; structureless; quartz gravels.
14 - 28"	(2.5YR 8/4); pale yellow sandy clay; rust mottling along old bedding planes of parent rock.
28 - 50"	(10YR 7/8); yellow to pure white sandy clay; common diffuse large yellow mottling to yellow-red soft concretions.
50 - 63"+	Pure white clay with colours of parent rock showing in traces; clearly marked bedding planes; breaks and fractures as schist (parent rock).

Type Location: Mahdia Valley

Range in Characteristics: In Mahdia valley the soil contains considerable quartz derived from white sand colluvium. The range in characteristics is still to be defined, 1965. It is suggested that white colour of the clay substratum need not be required as a characteristic of the series.

Competing Series and their Differentiae: Marabunta Creek soils have more mottling in the subsoil, less permeable substratum, and more sand throughout the profile than Durban soils, and are located on lower and more gentle slopes.

Setting: Located on lower slopes of creek valleys in the Mahdia Valley area, in many places adjoining areas of Tiwiwid sand or other sandy soils that lie on the higher uplands.

Principal Associated Soils: Tiwiwid, Tabela or Kasarama soils on higher areas of alluvial soils on adjacent flood plains; Durban soils on some higher bench slopes of acid igneous rocks; and Tiger Creek soils on benches of basic igneous rocks.

Drainage and Permeability: Estimated to be well drained or moderately well drained. Probably slowly permeable.

Vegetation and Use: The native vegetation is rain forest. These soils were not listed by Stark (1959) as suitable for cultivation in the Mahdia area, but might be suitable for pasture.

Distribution and Extent: Marabunta soils make up 18 percent of the area surveyed by Stark and others in the Mahdia Valley, 1959. Their wider distribution and extent are yet to be determined.

Series Established: Mahdia Valley, 1959.

Remarks: This description was taken from the published soil survey of the Mahdia Valley, and is subject to correction. It is suggested that the series should be defined to include sandy soils not more than 30 inches in depth, underlain by clay that apparently weathered from igneous rocks.

Source: Soil and Land Use Surveys No.5., British Guiana, Imperial College of Tropical Agriculture, Trinidad, W.I., April, 1959. Compiled in this form by J.G. Steele, July, 1965. Revised after trip of October 19th - 27th, 1965.

Marinero Series, 101

Soils of the Marinero series are classified as members of a clayey, acid, soft, sulphate-containing family of Aquic Haplorthents; also as Low Humic Gley soils, very poorly drained. The surface soil is dark grey or dark greyish brown, generally silty clay. The upper subsoil is grey clay mottled with yellowish brown. Below a depth of 9 to 18 inches the subsoil and substratum are grey or greenish grey clay that contains pieces of organic matter and in most places contains acid sulphates.

Typifying Pedon: Representative profile of Marinero silty clay.

A1	0 - 4"	Greyish brown (10YR 5/2) silty clay; massive structure; plastic, slightly sticky; many fine roots; very strongly acid, smooth boundary.
C1g	4 - 20"	Grey (5Y 6/1) clay mottled yellowish brown, (10YR 5/8), mottles are many, fine and prominent; massive structure; plastic, slightly sticky; common fine roots; very strong acid; gradual, smooth boundary.
C2g	20 - 36"	Grey (5Y 6/1) clay mottled with yellowish brown (10YR 5/4), mottles are few, fine and prominent and run along old root channels, massive structure; slightly plastic, sticky; slightly acid; gradual, smooth boundary.
C3g	36 - 48"+	Greenish grey (5BG 6/1) clay; massive structure; sticky, non sticky, non plastic; horizon contains many black organic specks, and bits of undecomposed plant material; neutral.

Type Location: The typical profile was described at a location 100 feet east of the Pomeroon River and ¼ mile south of Callestro's farm, in the Essequibo District.

Range in Characteristics: Colour of the surface soil ranges from grey to dark brown; texture from clay to silt loam. Depth to the greenish grey, soft, clay ranges from 9 to 18 inches. Toxic sulphides or sulphates are present in the soft clay in most places. A peaty phase has from 8 to 16 inches of peat over the mineral soil.

Competing Series and their Differentiae: Marinero soils consist of 9 to 18 inches of firm clay to silt loam over soft, greenish grey clay that contains organic matter. Mara soils (21) consist of the soft greenish grey clay from the surface downward, generally under a layer of peat, and lack the layer of firm mineral soil. In Brickery soils (36) the depth of soft, greenish grey clay is greater, from 18 to 36 inches. Marinero soils do not have the substratum of peat that is present in Inki soils (100).

Setting: Marinero soils are near the margins of peat swamps, in many places adjoining areas of Mara soils (21) or of Inki soils (100). They are lower and more difficult to drain than Brickery soils (36) or Tuschen soils (39).

Principal Associated Soils: Mara soils (21), Inki soils (100) or Anira peat (20) are in nearby swamps. Brickery soils (36) are in slightly higher places, and Tuschen soils (39), Everton soils (31a), or De Velde soils (1c or 1s) are on higher parts of the natural levees along streams.

Drainage and Permeability: Very poorly drained; very slowly permeable.

Vegetation and Use: Native vegetation is water-tolerant tropical forest. The soils are very low in fertility, very strongly acid, and difficult to drain. Moreover, thorough drainage would lead to oxidation of the sulphides and formation of an extremely acid soil. Strict control of water, to keep the level below roots of most crops without permitting too much drainage, is therefore required for growth of crops. Land capability subclass IIIt.

Distribution and Extent: Marinero soils lie in scattered areas throughout the coastal plain. The total area in British Guiana probably is not more than 20 to 40 square miles, and perhaps is much less.

Series Established: Soil Survey, Mahaica-Mahaicony-Abary Area, 1962.

Remarks: None.

Sources: Soil Survey, Mahaica-Mahaicony-Abary Area, preliminary report 1964, and Tapakuma Extension, 1964. Compiled in this form by J. G. Steele, March 1966.

Mibirikuru Series, 740

Soils of the Mibirikuru series are classified as members of a fine loamy family of Oxic Ochraquults; and as Low Humic Gley soils, very poorly drained. They have a dark grey or black surface soil of loamy sand, over a subsoil of sandy clay loam that is light yellowish brown to light grey.

Typifying Pedon: Representative profile of Mibirikuru loamy sand.

A1	0 - 7"	Very dark grey (10YR 3/1) loamy sand; weak fine granular structure; loose; common fine roots; extremely acid; gradual boundary.
A3	7 - 14"	Dark grey (10YR 4/1) sandy loam; weak medium to fine granular structure; friable; slightly plastic, non sticky; evidence of earthworm activity; few fine roots; extremely acid; clear smooth boundary.
B1g	14 - 22"	Grey (10YR 6/1) to light grey sandy clay loam; common, medium, distinct white concretionary mottles; medium to coarse granular structure; friable but firm in places; slightly plastic; slightly sticky; few filled holes of soil animals; occasional fine roots; extremely acid; clear, smooth boundary.
B2g	22 - 36"	Light grey (2.5YR 7/2) sandy clay loam; few medium and large yellow and red concretionary mottles; weak medium to fine subangular blocky structure; slightly plastic; slightly sticky; filled holes of soil animals appearing over entire horizon; large pockets of dark soil material run into horizon; extremely acid; gradual boundary.
Cg	36 - 48"+	Light grey (5Y 7/1) sandy clay loam to sandy clay; massive structure; moderately firm, slightly plastic; slightly sticky; seepage water below 40"; extremely acid.

Type Location: The representative profile was described and sampled about 6 mile northwest of Takama, near the Berbice River in northeastern British Guiana.

Range in Characteristics: Texture of the surface soil is loamy sand or sandy loam; its colour ranges from dark grey to black. Texture of the subsoil ranges from sandy loam to sandy clay loam, and its colour from grey to light yellowish brown. In some places the subsoil is mottled with red or yellowish brown, or contains soft concretions.

Competing Series and their Differentiae: Mibirikuru soils are finer textured than Henrietta (730) or Siparuta (732) soils; and coarser textured than Arima (750) or Aroaima (752) soils. The dark coloured surface layer is not so thick as in the Wiruni soils (742) which are of similar texture. They have greyer subsoil and are more poorly drained than Kasarama soils.

Setting: Mibirikuru soils are along small streams and in narrow, long depressions and potholes, in medium-textured sediments of the Berbice formation. In some places the micro relief is very uneven, with steep-sided humps about 1 foot in height. The substratum in many places is finer textured than the subsoil.

Principal Associated Soils: Kasarama soils (810) adjoin many areas of Mibirikuru soils, and in some places the gradation is so wide that the boundary is difficult to establish. Tabela soils are on the more sandy, higher locations. Wiruni soils (742) are in low places where the soil is similar in texture, but has a deeper dark-coloured layer. Henrietta (730) Siparuta (732), Arima (750) and Aroaima (752) soils are other soils along streams and in depressions, but they differ in texture as described from Mibirikuru soils.

Drainage and Permeability: Mibirikuru soils are very poorly drained, and probably are slowly or very slowly permeable. Lack of outlets prevents satisfactory artificial drainage in most places. Many areas are flooded for part of each rainy season.

Vegetation and Use: Native vegetation is forest or savannah, the soils are extremely acid and low in natural fertility. Many areas are flooded during part of each year and are difficult to drain. Some crops or pasture might be produced during the dry seasons, but fertilizer and lime would be required for crops or for any except very low yields of pasture grasses. Land-capability subclass 1Vw.

Distribution and Extent: Mibirikuru soils occupy about 4,500 acres in the Ebini-Ituni-Kwakwani soil survey. They probably are of small but significant extent throughout the gently sloping sandy plains.

Series Established: Soil Survey of the Ebini-Ituni-Kwakwani Area, 1963.

Remarks: The soils were classified as Typic Ochraquults by G.H.Robinson in 1963. Chemical analysis shows cation-exchange capacity of the surface layer (by KCl) of 1.1 milli-equivalent per 100 grams of soil, and 18 percent base saturation. It is suggested, therefore, that the subgroup should be Oxic Ochraquults.

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary report, 1964. Compiled in this form by J. G. Steele, January, 1966.

Minnehaha Series

Soils of the Minnehaha series were named and mapped in the soil survey of the Mahdia Valley, published in 1959. The soils are described as generally steep, with surface soil of brown sandy clay and subsoil of red clay containing common fine quartz gravel.

On the basis of the published description, and field observations in March, 1966, the soils named Minnehaha appear to be steep soils within the range of the Wauna series.

The Minnehaha series therefore is combined with the Wauna series.

Mixed Alluvial Land, 766

A mapping unit of Mixed Alluvial Land (not a soil series) was mapped in the soil survey of the Ebini-Ituni-Kwakwani Area and described in the report of that survey, released in preliminary form in 1964. The soils consist of very poorly drained, generally stratified, sandy or clayey alluvium, and some of them have a layer of peat on the surface. Some contain buried horizons of organic material. They are low and very difficult to drain.

Other mapped units of soils on flood plains have been designated as Undifferentiated alluvial soils, Alluvial soils, undifferentiated, and simply as Alluvial soils. Some soils in those mapping units probably are well drained or moderately well drained.

Wherever the soils are subject to annual or more frequent floods, probably little need exists to define soil series or to map in detail the kinds of soil.

Moleson Series, 8

In the Moleson series are soils classified as Aquic Haplorthents, members of a fine silty, acid family (Alluvial soils grading toward Low Humic Gley; somewhat poorly drained). Typically the soil has a surface layer of brown silt loam and a subsoil that is yellowish brown mottled with grey.

A1	0 - 6"	Greyish brown (10YR 5/2) silt with few fine and faint yellowish brown mottles in lower part of horizon; weak fine granular structure; friable; many, fine and medium, few large roots; very strongly acid; clear, smooth boundary.
A2	6 - 10"	Mottled light brownish grey (10YR 6/2) and brown (10YR 6/3) silt loam with few, fine, faint, brownish yellow mottles; weak, medium granular structure; friable; penetration of material from above into first 3" of horizon; commonfine; few medium and large roots; few earthworm channels; very strongly acid; clear, smooth boundary.
Bc	10 - 26"	Pale brown (10YR 6/3) silt loam with many, medium distinct yellowish brown and brownish yellow mottles, also few yellowish red mottles mainly in upper part; weak fine subangular blocky structure; friable; common medium and fine, few large roots; thin discontinuous clay films; strongly acid; gradual boundary.
C1	26 - 46"	Pale brown (10YR 6/3) silt with common medium, distinct yellowish brown and dark brown mottles; friable but moderately firm; few fine and medium roots; scattered dark specks; some vertical cracks with clay films; mildly alkaline; gradual boundary.
C2	45 - 60"+	Pale brown (10YR 6/3) fine sandy loam with few, medium, distinct yellowish brown mottles; weak medium subangular blocky structure; friable; scattered dark specks; occasional fine roots; moderately alkaline.

Type Location: Berbice County, British Guiana, 4½ miles south of the village of Crabwood Creek and 900 feet west of Corentyne River.

Range in Characteristics: Colour of the A horizon ranges from dark greyish brown to dark brown. Colour of the upper subsoil (C horizons) ranges from strong brown to yellowish brown, mottled with grey and some reddish yellow. Mottles in the C horizon are mostly common, fine nd distinct in some places they are common, medium and prominent. In some profiles all the horizons are medium acid. The C horizons are stratified, and texture ranges from silt loam or very fine sand to clay. The soil below 42 inches in some places is marine clay. Colours given are those of the moist soil. If the soil dries, colour values are 1 or 2 units higher.

Competing Series and their Differentiae: The Moleson soils are somewhat browner and more friable, and have less prominent structure in subsoil horizons than the Everton soils (31a). They are more friable and better drained than the Plegt Anker (5) or the Black Bush (3) soils. They lack the streaks and spots of segrated iron that are common in the surface horizon of Plegt Anker soils. They are somewhat more friable and more brown than the De Velde soils (1).

Setting: Moleson soils are on the highest of the nearly level silty alluvial deposits (natural levees) along large streams in the coastal area. The substratum in some places is alkaline marine clay.

Principal Associated Soils: In many places Moleson soils lie in narrow bands next to the rivers, adjoining areas of De Velde clay (1c) or De Velde silt loam (1s).

Drainage and Permeability: Somewhat poorly drained or moderately well drained. Surface drainage (runoff) is moderate. Permeability is moderate.

Vegetation and Use: Native vegetation is tropical rain forest that contains bulletwood, crabwood, waitee, trysil, manicole, mora, wild plantain, mucru, and several kinds of bushes. A large part is in forest. Cleared areas are used for corn, coconuts, citrus, vegetables, banana, ground provisions, mangoes, and pawpaws. Crops respond well to drainage and to fertilizer. To maintain good yields, organic matter, lime and fertilizer are needed. Shrinkage is slight when the soil dries. Land-capability subclass If.

Distribution and Extent: Along large streams in the coastal section of British Guiana and probably in Surinam. Total area in Northeastern British Guiana is probably less then 4,000 acres.

Series Established: Soil Survey, Canje Area, 1963.

Remarks: The series appears to be a close competitor with the silty range of the more poorly drained De Velde series (1s). Possibly the Moleson series should be enlarged to take in the silty De Velde soils, and the De Velde series restricted to the clayey soils (1c and 1s).

Sources: Described by Glenn H. Robinson, 23.11.63. See also soil survey reports of the Mahaica-Mahaicony-Abary Area, February, 1964, and the Canje Area, May, 1964. Arranged in this form by J. G. Steele, August, 1965.

Mountain Point Series

In the Mountain Point series are soils classified as Typic Udorthox, member of a clayey family (Red-yellow Latosols, well drained). They have a brown surface soil of clay or clay loam, and a subsoil of reddish yellow or red clay or silty clay.

Typical Profile of Mountain Point clay loam, on upper part of a 2 percent slope.

0 - 8"	(7.5YR 5/6), strong brown clay to clay loam; structureless, hard massive; common small Mn and Fe concretions; roots common.
8 - 19"	(5YR 5/8), yellowish red clay; soft to slightly hard, structureless, common small Fe concretions; rare thin concretions, roots common.
19 - 45"	(5YR 6/8), reddish yellow clay to silty clay; soft to slightly hard; structureless; roots few to common; frequent Fe and rare Mn concretions.
45 - 70"	(5YR 4/8), red clay to silty clay; soft, structureless, few roots; common small Fe and rare dark red clay concretions.

Type Location: West of Rupununi River, south of Kanuku Mountains, in southwestern British Guiana.

Range in Characteristics: Not available, 1965.

Competing Series and their Differentiae: Mountain Point soils are brown over yellowish red, and lie over gneiss rocks, Wichabai soils are dusky red, over basic rocks.

Setting: Mountain Point soils are well-drained soils of the pediments. They developed generally from acid and intermediate gneiss and from blue hypersthene granite gneiss.

Principal Associated Soils: Sawariwau soils and Kaput soils are on adjacent undulating uplands, and Waruma soils n the depressions.

Drainage and Permeability: Well drained, probably moderately permeable unless allowed to dry out.

Vegetation and Use: Vegetation was described by Loxton and others as few Curatella Americana with Trachypogon plumosus and Aristida spp. The soil is used for grazing. According to Loxton it is essential that this series be kept with a complete grass cover. If the soil is exposed to sun and dries out, it acquires poor, brick-like physical condition.

Distribution and Extent: Mapped on 38 square miles in the Southern Savannahs. Further extent not known in 1965.

Series Established: Soil Surveys of Rupununi Research, published 1958.

Remarks: The published description does not contain all information needed. The classification and other statements are subject to correction.

Sources: Soil and Land Use Surveys No. 2, British Guiana, The Rupununi Savannahs/ I.C.T.A., March, 1958. Assembled in this form by J. G. Steele, 1965.

Nassau Series, 57

In the Nassau series are soils classified as Ochric Plinthaquults, members of a fine silty, moderately permeable (Low Humic Gley - Ground-Water Laterite intergrade, somewhat poorly drained) family. They have a surface soil of greyish brown to dark grey silt loam and a subsoil of silty clay loam that is light grey mottled with yellowish brown, or with red in the lower part.

Typical Profile of Nassau silt loam:

A1	0 - 6"	Greyish brown (10YR 5/2) silt loam, weak fine granular structure; friable; slightly sticky; non plastic, common, medium and fine roots; vesicular pores are common; extremely acid; clear, smooth boundary.
A3	6 - 14"	Grey (10YR 6/1) silt loam; with few, fine prominent reddish brown mottles; weak, fine granular structure; friable; slightly sticky; non plastic; common medium and fine roots; some dead roots present; extremely acid; clear, smooth boundary.
B1	14 - 22"	Light grey (5Y 7/1) silt loam, with common, medium, prominent yellowish brown mottles; weak, medium and coarse angular blocky structure; friable; slightly sticky and plastic; darker material from above; few fine roots; few wormcasts present; extremely acid; clear, smooth boundary.
B2	22 - 32"	Light grey (5Y 7/1) silt loam, with common, medium, prominent yellowish brown and yellowish red mottles; weak medium and coarse angular blocky structure; friable; slightly sticky, slightly plastic; extremely acid; clear, smooth boundary.
C	32 - 48"+	Light grey (5Y 7/1) silty clay loam with many, large, prominent dark red and yellowish brown mottles; coarse angular blocky structure; sticky and plastic; few roots present; extremely acid.

Type Location: About 4 miles west of Ikuruwa Creek and 7 miles south of Canje River, in Berbice County, British Guiana.

Range in Characteristics: Colour of the surface soil ranges from greyish brown or grey, and that of the subsurface soil from light brownish grey to grey. Texture of the lower subsoil ranges from silt loam to silty clay. The depth to the first red mottling ranges from 30 to more than 48 inches. Some of the red mottles are concretionary.

Competing Series and their Differentiae: Nassau soils are less well drained, have more grey in the subsoil, and have a more prominent A2 horizon than Dageraad soils (58). They are better drained and lack the prominent red mottles that are in the upper subsoil of Helvetia soils (52). They resemble Potoco soils but appear to contain less organic matter, and they have native vegetation of grasses rather than forest trees.

Setting: Nassau soils developed in silty sediments on old terraces of the Coropina formation. They are nearly level or gently sloping; the greatest slopeprobably is not more than 3 percent. The substratum is mostly silty clay loam or silty clay.

Principal Associated Soils: Dagaraad soils (58) are in higher, more sloping or otherwise better drained positions. Helvetia soils and Kamani soils are in more poorly drained positions.

Drainage and Permeability: Somewhat poorly drained. Surface drainage is slow. Permeability is moderate.

Vegetation and Use: Native vegetation is grasses and other savannah plants. Most areas are used for pasture. The soil is easy to drain, and has good physical properties for most crops except rice. With lime and fertilizer it should produce moderate or good yields of orchard crops, rubber, bananas, ground provisions or many other common crops. Land-capability subclass IIf.

Distribution and Extent: In savannahs of the inner coastal Plain near the boundary of the more sloping sandy soils in northeastern British Guiana.

Series Established: Soil Survey of Canje Area, British Guiana, 1963.

Remarks: The description resembles greatly that of the Potoco soils (157). The soils should be studied further, and possibly correlated in one series.

Sources: Soil Survey of the Canje Area, British Guiana, by Robert Brinkman, 1964. Arranged in this form by J. G. Steele, July, 1965.

Novar Series, 70

Soils of the Novar series are classified (tentatively) as members of an acid family of Aquic Quartzipsamments; and as Regosols, well drained or moderately well drained. They have brown or dark brown surface soil of loamy sand, yellowish brown subsoil of loamy sand or sandy loam, and substratum of loamy sand or sand.

Typifying Pedon: Representative profile of Novar loamy sand.

A1	0 - 9"	Dark brown (7.5YR 4/4), (10YR 5/3), dry, loamy sand; very fine granular structure; loose, fine and medium roots are common, strongly acid; gradual, wavy boundary.
A3	9 - 15"	Dark brown (7.5YR 4/4) loamy sand mottled with strong brown and dark brown; mottles are many, fine and distinct; loose; few medium roots; strongly acid; clear, smooth boundary.
B2	15 - 24"	Yellow brown (10YR 5/6) sandy loam mottled with dark brown and brownish yellow; mottles are many, fine and distinct; friable; few medium roots; extremely acid; gradual, wavy boundary.
C1	24 - 32"	Mottled yellowish brown (10YR 5/6) very pale brown (10YR 7/4) and strong brown (7.5YR 5/8) loamy sand; friable; few medium roots; extremely acid; gradual wavy boundary.
C2	32"+	Very pale brown (10YR 7/4) loamy sand, mottled with pale yellow and yellowish red; mottles are common, medium and prominent, friable; acidity decreases with depth.

Type Location: The representative profile was described and sampled at Letter "T" Estate, Abary, one-half mile east of stable buildings.

Range in Characteristics: The range in natural drainage is from well-drained to moderately well-drained. The moderately well-drained soils are more mottled and have more pale brown in the subsoil than the one described. Soluble salts are present in some places, especially in the lower subsoil.

Competing Series and their Differentiae: Novar soils have more acid subsoil and a more sandy substratum than Ithaca soils (72). They are much more sandy and have better natural drainage than Whim soils (75).

Setting: Novar soils are on narrow strips of sand called reefs, approximately parallel to the coast, and 1 foot to 4 feet higher than the surrounding clay soils. The ridges probably are old beach lines.

Principal Associated Soils: Novar soils are associated with the sandy substratum phases of Buxton (45), Rosignol (43s), Lichfield (42s), and Onverwagt (41s) soils. Ithaca soils (72) or Whim soils (75) probably could be identified in many adjoining areas too small to be mapped at the scale of the soil surveys.

Drainage and Permeability: Well-drained or moderately well-drained, rapidly permeable.

Vegetation and Use: Native vegetation was forest. Many of the ridges are now marked by groves of coconut trees. The soils are acid and low in nutrients, but are easy to work. They are not suited for rice or sugar cane. Although some crops can be grown without irrigation, a supply of water would ensure more dependable yields. With lime and fertilizer the soils are well suited for coconuts and ground provisions, and moderately well suited for maize, pasture, and several other crops. Land-capability subclass If.

Distribution and Extent: Extent is extremely small, in mapped areas at the scale of the semi-detailed soil survey. Only 230 acres were mapped in the Mahaica-Mahaicony-Abary Area, and none in the Canje Area. Further extent in areas to be surveyed probably is small.

Series Established: Soil Survey, Mahaica-Mahaicony-Abary Area, 1962.

Remarks: Although Novar soils occupy a small total area, it is assumed that they are distinctive enough to justify retention as a separate series. Only three series of soils on the sandy ridges, Novar, Ithaca and Whim, have been classified. C.H.Simonson in 1955-56 identified more than three soils that he believed should be classified at the series level. It is believed, however, that the three series established in 1962-63 are adequate for present needs in soil mapping and interpretations.

Source: Soil Survey, Mahaica-Mahaicony-Abary Area, preliminary release, 1964. Compiled in this form by J. G. Steele, December, 1965.

Onverwagt Series 41

Soils of the Onverwagt series are classified as members of a clayey family of Typic Ochraquults, also as Low Humic Gley soils, poorly drained. They have a thin dark grey or very dark grey surface soil and a subsoil of clay that is greenish grey mottled with strong brown and yellowish red. The upper horizons are strongly acid, but the soil below a depth of 24 to 30 inches is neutral or slightly alkaline.

Typifying Pedon: Representative profile of Onverwagt clay.

A1	0 - 5"	Very dark grey (10YR 3/1) clay; fine granular structure; friable; non plastic; many fine fibrous roots; extremely acid; gradual, wavy boundary.
A3g	5 - 10"	Grey (10YR 5/1) clay mottled with reddish yellow, brownish yellow and strong brown; mottles are common, medium and prominent occurring mainly along root channels; medium subangular blocky structure; sticky and slightly plastic; fine roots are common; very strongly acid; clear, smooth boundary.
B2g	10 - 24"	Grey (5Y 6/1) clay mottled with reddish yellow, strong brown and dark red; mottles are many, medium and prominent; massive structure; firm; sticky and plastic; few fine roots and old root channels; strongly acid; gradual wavy boundary.
B3g	24 - 38"	Greenish grey (5GY 6/1) clay mottled with yellowish brown and some dark red; mottles are common, medium and prominent; massive structure; sticky and plastic; firm; few fine and medium roots; strongly acid, gradual wavy boundary.
C1g	38 - 48"	Greenish grey (5GY 6/1) clay mottled with yellowish brown; mottles are common, medium and prominent but less than in the overlying horizon; massive structure; sticky and plastic, neutral; gradual, wavy boundary.
C2g	48"+	Light bluish grey (5BG 7/1) clay mottled with yellowish brown; mottles are common, medium and prominent but less than in the overyling horizon; massive structure; sticky and plastic; neutral.

Type Location: The representative profile was described and sampled one-half mile south of Blairmont Canal, one-half mile east of the Abary River.

Range in Characteristics: Colour of the A horizon ranges from black to dark grey; texture from clay to silty clay loam. Mottling in the B horizon in most places is reddish yellow to yellowish brown, but in some places it is red. Some reddish brown concretionary material is present in the substratum. The surface soil is extremely acid, but that below 24 to 36 inches is neutral or alkaline. In some places, especially near a stream that contains brackish water, the soil has a high content of soluble salts. A sandy substratum phase was recognized.

Competing Series and their Differentiae: Onverwagt soils have a firmer, much more mottled subsoil than the Corentyne soils (11). They have weaker structure and are more friable in the B horizon than the Everton soils (31a). They have better natural drainage and a surface soil that is less dark coloured than that of the Rosignol soils (43).

Setting: Onverwagt soils are level, within the zone of marine sediments known as frontland clays.

Principal Associated Soils: Other soils of the frontland clays are members of the Buxton (45), Lichfield(42), and Rosignol(43) series. Soils of the Canje (31), Everton (31a), and Kerkenama (32) series are in slightly higher areas of alluvial sediments.

Drainage and Permeability: Poorly drained, probably slowly or moderately permeable.

Vegetation and Use: Native vegetation is mainly wet savannah. The upper horizons are acid and low in phosphorus, calcium, and potassium. The soils are easy to drain. With drainage, lime and fertilizers, they are well suited or moderately well suited for many of the common crops, but not for root crops. Land-capability subclass Im.

Distribution and Extent: Extent in the area covered by soil surveys is about 45,000 acres, all in the Mahaica-Mahaicony-Abary Area. Further extent in parts of the coastal plain not yet covered by soil surveys probably is less than the amount already mapped.

Series Established: Soil Survey of Mahaica-Mahaicony-Abary Area, 1962.

Remarks: The sandy substratum phase has a moderately high content of soluble salts, but is moderately permeable and can be reclaimed with moderate difficulty. It is then only moderately well suited for salt sensitive plants such as beans and corn. Until salt has been leached, the moderately saline soils are in capability subclass IIs. After leaching it is necessary to prevent flooding with brackish water.

Source: Soil Survey report, Mahaica-Mahaicony-Abary Area, preliminary release, February, 1964. Arranged in this form by J. G. Steele, November, 1965.

Pakaraima Complex

The name Pakaraima complex was applied to soils on the lower mountain slopes bordering the savannahs in the soil survey of Rupununi Savannahs (continued), published 1959. The report states that although the component series were left un-named, the soils were referred to collectively as the Pakaraima complex for identification purposes.

Since the name has been used in this general sense in a published soil report, and since it is also the name of a large physiographic division, it is suggested that it is not appropriate for a soil series. Other names should be selected for the soils that are defined in the Pakaraima Mountains and Plateau.

Plegt Anker Series 5

In the Plegt Anker series are soils classified as Aquic Haplorthents, members of a clayey, acid family (Low Humic Gley, poorly drained). Typically the surface soil is thin grey or dark grey clay. The subsoil is grey or greenish grey clay.

Typical Profile of Plegt Anker clay in a cultivated area:

Ap	0 - 8"	Dark grey (10YR 4/1 - 5/1) clay mottled with dark brown and red; moderate fine subangular blocky structure; plastic and slightly sticky; numerous fine roots; very strongly acid; abrupt smooth boundary.
C1g	8 - 16"	Grey (5Y 6/1) clay with many, large prominent brownish yellow, dark grey and yellowish red mottles; the dark grey material is from the A horizon and has fallen into cracks; some of the cracks have been cut off by ploughing and are not continuous to the surface; coarse prismatic structure; plastic and sticky; the yellowish red colours tend to follow root channels; the faces of some cracks have coatings of dark reddish brown and yellowish brown which appear to be segregated iron; strongly acid; gradual and somewhat wavy boundary.
C2g	16 - 36"	Grey (5Y 6/1) silty clay with many, large prominent brownish yellow and grey mottles; dark red mottling is present along few root channels; medium and fine roots are common;clay flows are distinct on vertical faces; structure appears to be largely massive with some cracks from horizon above; plastic and sticky; slightly acid; abrupt smooth boundary.
C3g	36 - 40"	Grey (5Y 6/1) silt loam with common, medium, prominent greenish grey and yellowish brown mottles; few medium and fine root channels and occasional roots; few soft iron concretions; soil material breaks into irregular blocks with clay flows on vertical faces and in old root channels; plastic and sticky;mildly alkaline; abrupt smooth boundary.
C4g	40 - 66"	Greenish grey (5BG 6/1) silty clay with common medium, prominent yellowish brown mottles; tendency to break into large irregular blocks with clay flows on some of the faces; few soft concretions and evidence that part of mottling is beginning of concretions; few medium size root channels and some fine roots; grey clay flows in part of root channels; plastic and sticky; mildly alkaline.

Type Location: South of the village of Crabwood Creek, 500 feet southwest of the junction of Crabwood Creek dam and the road, in Berbice County, British Guiana.

Range in Characteristics: The principal types are clay and silty clay. Colour of the surface soil ranges from very dark grey to grey, and that of the deeper horizons from grey to olive grey. Mottles in the subsoil are mostly common, medium, and prominent, but in some places are fine and distinct; colour of the mottles is yellowish red, yellowish brown, or dark red. Structure is mostly massive but the soil cracks into irregular blocks on drying. Underlying soil material below 36 to 40 inches in some places is alkaline marine clay. Colours given are those of the moist soil. If the soil dries, colour values are 1 or 2 units higher.

Competing Series and their Differentiae: Plegt Anker soils are more friable and have less prominent soil structure than the Everton soils (31a). They are more friable, have less prominent structure; and have less acid subsoil, than the Canje soils (31). They are better drained and are not so grey as the Black Bush soils. They contain spots and streaks of segregated iron or red coatings on peds, in the surface horizons; such spots and streaks are not present in the Black Bush or the De Velde soils. They have darker surface soil, contain more organic matter, and are more poorly drained than Moleson soils.

Setting: Plegt Anker soils developed in moderately fine or fine textured alluvium, partly mixed with marine materials. They are along streams in the coastal areas that contain or have contained brackish water. They are nearly level or in slight depressions, but are slightly higher than the swamps that are near most of the areas.

Principal Associated Soils: Plegt Anker soils are associated mainly with Everton (31a) and Canje (31) soils.

Drainage and Permeability: Poorly or very poorly drained. Surface drainage is slow. Permeability is slow or moderate. Shrinkage on drying is slight or moderate.

Vegetation and Use: Native vegetation is tropical rain forest that contains long john, mucru, kokerite palm, silk cotton, congo pump, trysil, wild plantain, moco-moco, and several kinds of bushes. A large part is in forest. Cleared areas are used for rice, sugar cane, bananas, plantains, ground provisions and some vegetables. Crops respond well to drainage and the soil holds water well for production of rice. To maintain good yields, organic matter, lime and fertilizer are needed. Land-capability subclass If.

Distribution and Extent: Located near streams in the coastal plain of British Guiana and probably in Surinam. Total extent in the Canje and Mahaica-Mahaicony-Abary area is about 8,000 acres.

Series Established: Canje Area, British Guiana, 1963.

Remarks: None.

Sources: Described by Glenn H. Robinson, 23.11.63. Arranged in this form by J. G. Steele, August, 1965.

Potoco Series, 157

In the Potoco series are soils classified as Oxic Ochraquults, members of a fine silty family (poorly drained or somewhat poorly drained, Low Humic Gley - Ground-Water Laterite intergrade). They have a dark greyish brown, silty surface soil, and a light grey silty clay loam subsoil mottled with brownish yellowish and red. The substratum is light grey silt loam mottled with dark red and yellowish brown.

Typical Profile of Potoco silt loam.

O1	1 - 0"	Leaves and other vegetative residue.
A1	0 - 9"	Greyish brown (10YR 5/2) silt loam; weak fine granular structure; very friable; slightly plastic; many fine and medium roots, occasional large roots; many small root holes and worm channels; extremely acid; gradual smooth boundary.
A3	9 - 15"	Grey to greyish brown(10YR 6/1 - 5/2) silt loam with few, fine faint, yellowish brown and light yellowish brown mottles; medium to fine subangular blocky structure; friable; slightly sticky and slightly plastic; some fine roots and old root channels; extremely acid; gradual, smooth boundary.
B1	15 - 24"	Light grey to grey (10YR 7/1 - 6/1) silt loam with common, fine, distinct yellowish brown and strong brown mottles; soil breaks into irregular clods; friable; slightly sticky and slightly plastic; some evidence of clay flows; extremely acid; clear, smooth boundary.
B2g	24 - 29"	Light grey to grey (10YR 7/1 - 6/1) silty clay loam, with many, medium, distinct yellowish brown and strong brown mottles; medium to fine subangular blocky structure; thin clay skins; friable; many old root channels and worm holes; few fine roots; extremely acid; gradual, smooth boundary.
B3g	29 - 60"	Light grey (5Y 7/1) clay; many, medium, prominent, weak red and yellowish brown mottles in upper part with dark red mottles below 48 inches; medium angular blocky structure; thin clay skins around each ped; firm to friable; slightly sticky and plastic; dark red mottles are cemented, hence soil feels gritty when crushed in hand; few fine roots and old root channels; extremely acid.

Type Location: Two miles north of Torani Canal and four miles west of Canje River in Berbice County, British Guiana.

Range in Characteristics: Colour of the A horizon ranges from dark greyish brown to grey. Mottling in the B horizon is predominantly brownish yellow but some yellowish red and red can also be present. Dark red mottles are common in the C horizon, and they are likely to be very firm and to harden on exposure to air. Texture of the B horizon is silty clay loam or silty clay. The substratum in some places is silty clay or clay, some of marine origin. Colours are given for the moist soil. If the soil dries, values are one or two units higher.

Competing Series and their Differentiae: Potoco soils have subsoil more mottled and gleyed than that of the Yesi soils, the subsurface soil has a few faint mottles and the upper B horizon has common prominent mottles. Potoco soils are less gleyed in the subsoil, and have reticulate red mottles at greater depth than the Torani soils. They are higher, more sloping, and less wet than the Cola or the Putkin soils. They lack the dense silty horizon (fragipan) that is present in the Kamani soils.

Setting: Potoco soils developed under forest cover in silty sediments on old terraces of the Coropina formation. They lie along streams and near former streams channels. They are nearly level or gently sloping; the greatest slope is about 3 percent. The substratum contains a high percentage of silt and is strongly leached.

Principal Associated Soils: The better drained Yesi soils and the more poorly drained Cola and Putkin soils adjoin the Yesi soils in many places. North of the Torani Canal, Potoco and Bartica soils lie slightly higher than adjoining areas of Anira and of Mara soils.

Drainage and Permeability: Close of natural drainage is poor or somewhat poor. Slow surface runoff and moderate internal drainage. Moderate permeability.

Vegetation and Use: Native vegetation is tropical rain forest. Major plants have been identified as Long John (triplaris surinamensis), Mucru (Ischnosiphon arouma), Kokerite palm (Maximiliana regia), Mora (Mora excelsa), Jamoon (Eugenia jambolana), silk cotton (Ceiba pentandra), Bloodwood (Vismia angusta), Korokara (Didymophanax morototonii), wild plantain (Heliconia psittacorum), and several kinds of low bushes.

A large part is in forest. Cleared areas are used for bananas, plantains, coconuts, ground provisions and pasture. Shifting cultivation is common.

Distribution and Extent: On stream terraces of the Coropina formation in British Guiana and probably in Surinam. Similar soils have been observed on some stream terraces in the interior of British Guiana.

Series Established: Soil Survey of the Canje Area, 1963.

Remarks: Natural soil fertility is very low. It is expected that crops will respond well to drainage, fertilizers and lime. Potoco soils (157) and Nassau soils (57) should be re-studied in the field to see if they should be correlated in one series.

Sources: Described by Glenn H. Robinson, November, 1953. Arranged in this form by J. G. Steele, July, 1965.

Prosperity Creek Series

Soils of the Prosperity Creek series were named and mapped in the soil survey of the Mahulia Valley, published in 1959. Study of the description, and field studies of the soils in 1965 and 1966, suggest that the soils can be classified as steep phases of Tiger Creek soils. It is therefore suggested, in 1966, that the name can be dropped unless further field studies reveal that the soils should be named as a separate series.

Putkin Series, 156

In the Putkin series are soils classified as Oxic Ochraquults, members of a fine silty family (poorly drained, Low Humic Gley). They have a thin, dark grey surface soil of silt loam or silty clay loam, and a subsoil of yellow, grey and red mottled silt loam or silty clay loam.

Typical Profile of Putkin silt loam in a forested area:

A1	0 - 6"	Light grey (5Y 7/1) silt loam; weak fine granular structure; friable, non plastic and non sticky; common, medium and fine roots; extremely acid; gradual, smooth boundary.
A2	6 - 16"	Light grey to white (5Y 7/1 - 8/1) silt loam with few, medium, prominent yellowish brown mottles, mainly in lower part of horizon; weak, medium granular structure; friable; slightly plastic and slightly sticky; common medium and fine roots; occasional large roots; extremely acid; clear, smooth boundary.
B1g	16 - 22"	Light grey (5Y 7/1) silt loam with common, medium, prominent, reddish yellow and strong brown mottles, weak; medium granular structure; friable; slightly plastic and slightly sticky; occasional fine roots; extremely acid; gradual, smooth boundary.
B2g	22 - 39"	Grey (5Y 6/1) silty clay loam with common, medium, prominent strong brown and yellowish red mottles; massive structure;friable; slightly plastic and sticky; lenses of silt scattered throughout; extremely acid; gradual, smooth boundary.
C1g	39 - 50"+	Grey (5Y 6/1) silty clay with common, medium, prominent red and strong brown mottles; massive structure; firm; plastic and sticky; extremely acid.

Type Location: About 1 mile north of Torani Canal, near Torani East Lock, Canje River.

Range in Characteristics: In some places a dark coloured horizon, apparently the surface layer of a buried profile, is present within the profile.

Competing Series and their Differentiae: Putkin soils are more grey and more poorly drained than Potoco or Torani soils, and they lack red mottling in the subsoil that is characteristic of the Torani soils.

Setting: Putkin soils are in depressions on the silty terrace known as the Coropina formation. The underlying material is silty clay loam or silty clay. In some places a buried dark-coloured layer indicates that sediment has been deposited on a former surface.

Principal Associated Soils: Better drained soils of the Yesi, Potoco, Bartica, and Cola soils.

Drainage and Permeability: Poorly drained; surface drainage is very slow or ponded. Permeability probably is slow.

Vegetation and Use: Native vegetation is tropical forest. The soil is very strongly acid and low in plant nutrients. It is poorly suited for citrus or bananas, and moderately suited for ground provisions and some vegetables. Probably well suited for pasture except when too wet.

Distribution and Extent: In low places on silty terraces of the Coropina formation, along margins of the coastal plain near the sloping sandy soils, in British Guiana. Total extent probably is less than 5,000 acres.

Series Established: Soil Survey of Canje Area, 1963.

Remarks: If similar soils are found under savannah vegetation they should be correlated with this series.

Sources: Soil Survey of Canje area, by Robert Brinkman, 1964. Arranged in this form by J. G. Steele, July 1965.

Rosignol Series, 43

Soils of the Rosignol series are classified as members of a clayey family of Umbric Ochraquualfs; also as Humic Gley soils, very poorly drained. They have a thick surface soil of dark grey clay and a subsoil of clay that is grey mottled with strong brown and red. The substratum is greenish grey mottled clay. The surface soil is strongly acid but the soil below a depth of 18 to 30 inches is neutral or alkaline.

Typifying Pedon: Representative profile of Rosignol clay.

A1	0 - 10"	Black (10YR 2/1) clay mottled with dark grey; mottles are common, large and distinct and occur in the lower part of the horizon; weak, coarse angular blocky structure; firm; cracks ½" to 2" wide extend down to 20 inches; many fine roots; extremely acid; abrupt, broken boundary.
B2g	10 - 25"	Grey (5Y 5/1) clay mottled with strong brown and yellowish brown; mottles are many, large and distinct; massive to weak medium angular blocky structure; plastic, non sticky; fine roots are common; very strongly acid; clear, smooth boundary.
B3g	25 - 40"	Greenish grey (5GY 6/1) clay mottled with strong brown and brownish yellow; mottles are many fine and prominent; massive to weak medium angular blocky structure; plastic, non sticky; few fine roots; neutral; gradual boundary.
Cg	40 - 50"+	Greenish grey (5BG 6/1) clay mottled with dark reddish brown and yellowish brown (10YR 5/4); mottles are many, fine and distinct to prominent and occur mainly along old root channels; massive structure; plastic, non sticky; few thin silt lenses; mildly alkaline.

Type Location: The representative profile was described and sampled near Tiger, West Bank Abary, 2 miles west of the Abary River and 3 miles south of Jugdeo's canal.

Range in Characteristics: Colour of the surface soil is black or very dark grey. Red mottling is present in the B horizon at some places, although the usual range is reddish yellow to yellowish brown. Reddish brown concretions and thin lenses of silt are present at some places in the C horizon. Depth to the neutral or alkaline material is 24 to 36 inches. Shells are in the soil at some places. A drained phase and a sandy substratum phase have been recognized.

Competing Series and their Differentiae: Rosignol soils are similar to Lichfield soils (42) but do not have a yellowish brown B horizon; the base colour of the B horizon is grey or greenish grey. They are more poorly drained and have darker coloured surface soil than the Onverwagt (41) soils. Their B horizon is more friable and has weaker structure than that of the Canje (31) or Brandwagt (32a) soils.

Setting: Rosignol soils are in very poorly drained places within the area of frontland clays. The surface soil and subsoil are firm; the substratum is soft marine clay.

Principal Associated Soils: Rosignol soils are associated mainly with Onverwagt (41) and Buxton (45) soils; Canje (31), Everton (31a) and Brandwagt (32a) soils are in slightly higher areas.

Drainage and Permeability: Very poorly drained; slowly or moderately permeable, easy to drain.

Vegetation and Use: Native vegetation is wet savannah or water tolerant forest. The surface soil is acid and as a rule is low in phosphorus and potassium. The soils are easy to drain and till. With drainage, lime and complete fertilizer they are well suited for rice, pasture, ground provisions, and most vegetables. Land Capability subclass Im. The sandy substratum phase as a rule contains salts and without leaching is in capability subclass IIs. After drainage and leaching it is moderately well suited for coconuts, vegetables, sugar cane, orchard crops, and pasture, and well suited for rice and ground provisions.

Distribution and Extent: Rosignol soils amounting to about 78 square miles were mapped in the Mahaica-Mahaicony-Abary Area. Further extent in the coastal plain probably is no greater.

Series Established: Mahaica-Mahaicony-Abary Area, 1962.

Remarks: Shells are present at some places but would be regarded as mapping inclusions rather than within the range of the series.

Source: Soil Survey, Mahaica-Mahaicony-Abary Area, preliminary release, February, 1964. Compiled in this form by J. G. Steele, November, 1965.

Rupununi Series

Soils of the Rupununi series are members of a clayey acid family of Aquic Haplorthents. They are also classified as alluvial soils, poorly drained. The surface layer is dark greyish brown mucky clay; beneath it is grey clay to a depth of 6 feet.

Typifying Pedon: Typical profile of Rupununi clay.

0 - 5"	(10YR 4/2) dark grey-brown mucky clay with many roots.
5 - 72"	(10YR 5/1) grey clay, with a strong, fine angular blocky structure; hard; fine soft brown concretions and common faint diffuse orange-brown mottling between 5 inches and 12 inches in the profile.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: Competing series were not established in the soil surveys published in 1958 and 1959. Suggett described a somewhat poorly drained alluvial soil (1964) that might be a companion series. The need for definition of soil series might not be great, however, among these soils that are flooded frequently.

Setting: Located on the flood plain of the Rupununi River above Annai. The upper sediments are clayey as described in the typical profile, but along the river bank the clay overlies sandy beds which in some places overlie large, indurated bodies of laterite.

Principal Associated Soils: Benoni and Cachoeira soils are in the Mabarakanta Basin that lies between the Rupununi and the Ireng River west of Massara Village. Lithosols are on the adjoining mountain slopes.

Drainage and Permeability: Estimated to be somewhat poorly drained and slowly permeable. The soil is flooded for at least 3 months of each year.

Vegetation and Use: Vegetation was not described by Stark. Suggett described vegetation on his alluvial soils as grass with a few shrubs. Presumably used for grazing, but according to Stark "This soil does not have the reputation locally of being productive".

Distribution and Extent: Rupununi soils occupy about 12 square miles in the area covered by the soil survey of 1958 and 1959. Since that survey covered only one side of the Rupununi River for about 30 miles, the total extent must be much greater. If soils similar enough to be in the same series make up a significant proportion of Suggett's mapping unit Az, the total extent is in hundredsof square miles.

Series Established: Soil Survey of the Rupununi Savannahs continued, published 1959.

Remarks: Since flooding controls use of the alluvial soils and several other groups of soils in southern British Guiana, the need for detailed mapping of the soils is not urgent. Soils should be examined in enough places to get a reasonable idea of the series that are present. Some mapping more detailed than the reconnaissance soil survey of 1964 probably will be needed, but all the work should be done with prospective uses in mind.

Source: Compiled from Soil and Land-Use Surveys No. 6, British Guiana. Regional Research Centre, I.C.T.A., Trinidad, W.I., June 1959.

St. Ignatius Series

In the St. Ignatius series are soils classified as Typic Udorthox, member of a clayey skeletal family. They are also classified as Red-Yellow Latosols. They are characterised by outcropping ironstone pavement or the presence of ironstone gravel at the surface or at a depth or less than 3 feet.

Typical Profile of St. Ignatius: Sandy gravel.

0 - 10"	(10YR 4/2); dark greyish brown sandy gravel some Fe concretions and a few angular quartz pebbles up to 4 inches diameter. Strongly developed gravel pavement. Structureless. Few grass roots.
10 - 40"	(10YR 6/8) brownish yellow clayey gravel and few subangular quartz pebbles up to 6 inches diameter. Loose and cemented Fe concretions up to 9 inches. diameter. Few fine roots.
40 - 65"	(7.5YR 6/6) reddish yellow clayey gravel; Fe concretions in soft loose blocks up to 12 inches. Little matrix material. Structureless.

Type Location: Between St. Ignatius and the Kanuku Mountains, southwestern British Guiana.

Range in Characteristics: To be determined. It is suggested that soils having as much as 18 inches of gravelly clay should be classified in some other series, probably Lethem.

Competing Series and their Differentiae: Lethem soils have sandy clay loam or sandy clay in the upper profile, and are underlain by ironstone or by gravel.

Setting: St. Ignatius soils are on undulating uplands where the soil mass consists mostly of ironstone gravel or boulders, and outcrops of ironstone may be present.

Principal Associated Soils: Lethem soils contain more clay and may be underlain by ironstone gravel. Kuma soils are on adjacent gentle colluvial slopes.

Drainage and Permeability: Well drained or excessively drained; rapidly permeable, low water-holding capacity.

Vegetation and Use: Native vegetation is mostly short grassland savannah. Some bush island and some fringing forests are on these soils. Cultivation generally is not practical although cassava was seen growing at one place. The principal use is for extensive grazing of the native grass.

Distribution and Extent: Mapped on 62 square miles in the savannahs of southwestern British Guiana (1958 and 1959). Further extent, if any, to be determined (this was written in 1965).

Series Established: Soil Survey of Rupununi Savannahs, published 1958.

Remarks: The classification has been estimated from the published description. Ranges in characteristics need to be established and are not given definitely in the published soil survey.

Source: Soil and Land Use Surveys No. 2, British Guiana. The Rupununi Savannahs. Regional Research Centre, I.C.T.A., Trinidad, March, 1958. Compiled in this form by J. G. Steele, 1965.

Sawariwau Series

Soils of the Sawariwau series are classified as Oxic Normudults, members of a deep, loamy family; and as Red-Yellow Podzolic soils, well drained. They have on the surface stones of quartz and small boulders of magnetite. The surface soil is loamy sand; the subsoil is reddish yellow sandy loam and the substratum is grey clay with soft to hard bright red concretions.

Typical Profile of Sawariwau: Loamy sand.

0 - 12"	(10YR 6/2); light brownish grey loamy sand; hard; structureless.
12 - 22"	(7.5YR 6/8); reddish yellow sandy loam; moderately hard; structureless with some quartz pebbles, few roots.
22 - 37"	(7.5YR 5/6); strong brown sandy loam; soft; structureless. few roots.
37 - 41"	Gravel layer of quartz pebbles admixed with coarse sand, matrix (5Y 6/3) pale olive.
41 - 64"	(10YR 6/1); grey clay; soft friable; structureless; very frequent small to large, soft to hard bright red concretions; common faint disperse yellow mottling.
64"+	As above but becomes irregularly indurated with depth and concretions become harder.

Type Location: Near headwaters of Sawariwau River in southern Rupununi Savannahs of southwestern British Guiana.

Range in Characteristics: Not available in 1965. The substratum is weathered rock, clayey material with feeble but distinct evidence of geological structure. "A rather variable profile was permitted in this series".

Competing Series and their Differentiae: Sawariwau soils have a surface pavement of quartz stones and lack the ironstone outcrops or gravel that are characteristic of St. Ignatius, Lethem, and Kaput soils.

Setting: Loxton, Jones and others in the Soil Survey cited, believed that the area of Sawariwau soils is still in the primary erosion cycle; but that the area of St. Ignatius and Lethem soils has passed through its primary erosion cycle, and the lateritic ironstone and gravel there formed the parent material of the present soils.

Principal Associated Soils: Kaput and Waruma soils on undulating uplands where ironstone is present; Mountain Point or Wichabai soils on pediments adjacent to hills on which there are Lithosols.

Drainage and Permeability: Well drained, probably moderately permeable.

Vegetation and Use: Native vegetation is savannah grasses. These soils furnish some of the best grazing localities where cattle remain healthy and pasture seems more nutritive than in most other places. The physical characteristics of the soil are more favourable for plant growth than those of many other soils of the savannahs.

Distribution and Extent: Sawariwau soils occupy 57 square miles in the area covered by soil surveys, and probably extend further.

Series Established: Soil Survey of Rupununi Savannah, published 1958.

Remarks: Classification has been estimated from the published description. Characteristics and their ranges need to be defined more precisely.

Source: Soil and Land Use Survey No. 2, British Guiana, the Rupununi Savannahs, Regional Research Centre, I.C.T.A., Trinidad, 1958.

Serebekabra Series

The Serebekabra series was mapped and named in the Soil Survey of the Bartica Triangle, by J. Stark and others, published in 1959.

The soils are described as intergrades between Tiwiwid soils (white sand) and one or another of the brown sandy soils, presumably chiefly Tabela soils as they are now classified.

The name Serebekabra has been dropped, but can be restored if needed. It is likely, however, that the mapping units can be named as phases of one or another of the soils, or as complexes if the two kinds of soil are present in the same mapping unit.

Siparuta Series, 732

Soils of the Siparuta series are classified as members of an acid family of Umbric Aquipsamments; and as Humic Gley soils, very poorly drained. They have a thick very dark grey surface soil of sand over a grey subsoil of friable sand.

Typifying Pedon: Representative profile of Siparuta sand.

A1	0 - 12"	Very dark grey (10YR 3/1) sand with common white sand grains; single grain structure; slightly coherent; many fine roots; extremely acid; gradual boundary. A thin (1/8") layer of grey sand is present on the surface.
A12	12 - 20"	Very dark greyish brown (10YR 3/2) sand with common white grains; single grain structure; slightly coherent; common fine roots; extremely acid; clear boundary.
A3	20 - 36"	Dark greyish brown (10YR 4/2) sand; single grain structure; slightly coherent; few fine roots; extremely acid; gradual boundary.
C1	36 - 48"+	Dark greyish brown (10YR 4/2) loamy sand; massive structure; very friable; no roots; extremely acid.

Type Location: The representative profile was described and sampled about 3 miles southwest of the Ebini Livestock Station in northeastern British Guiana.

Range in Characteristics: Colour of the surface soil ranges from dark grey to black. Thickness of the dark layer ranges from 10 to more than 30 inches. Colour of the subsoil ranges from light grey to dark greyish brown. Texture of the subsoil is sand or loamy sand.

Competing Series and their Differentiae: Siparuta soils do not have the cemented pan that is characteristic of Ituni soils (701). The surface soil is thicker than that of Henrietta soils (730). The soils are much more poorly drained than Tabela soils (800) and the subsoil is more pale. Texture of the surface soil and subsoil is coarser than in Mibirikuru (740) or Wiruni (742) soils.

Setting: Siparuta soils are along small streams and in depressions or potholes, in sandy sediments of the Berbice formation. Slopes are gentle. Many of the depressions do not have outlets.

Principal Associated Soils: Tabela (800) Tiwiwid (700) and Kasarama (810) soils are in adjoining locations that have better natural drainage. Henrietta soils (730) are in similar low places and depressions where the soil is sand, and the dark layer is not more than 12 inches thick.

Drainage and Permeability: The soils are very poorly drained. The sandy layers in the soil profile are rapidly permeable, but the substratum in most places is slowly or very slowly permeable. Many areas are closed basins that do not have outlets for drainage.

Vegetation and Use: Native vegetation is forest or savannah. Some spots are covered with trees and surrounded by savannah. The soils are extremely acid, extremely low in natural fertility, and are very wet or flooded for part of practically every wet season. Drainage would be very difficult because of the lack of outlets. The soils are poorly suited for annual crops. They might be managed to provide some pasture during the dry seasons. Land capability subclass IVw.

Distribution and Extent: Siparuta soils occupy nearly 2,000 acres in the area covered by the Ebini-Ituni-Kwakwani Soil Survey. Extent throughout the gently sloping sandy plains is small but significant.

Series Established: Soil Survey of Ebini-Ituni-Kwakwani Area, 1963.

Remarks: None

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary report, 1964. Compiled in this form by J. G. Steele, January, 1966.

Skeldon Series, 13

Soils of the Skeldon series are members of a clayey, non-acid, soft or moderately firm family of Aquic Haplorthents. They are also classified as Low Humic Gley soils, poorly drained. They have a surface soil of dark grey strongly acid clay, an upper subsoil of strongly acid greenish grey clay, mottled with yellowish brown, and a lower subsoil of neutral greenish grey clay, mottled with olive brown.

Typifying Pedon: Typical profile of Skeldon Clay.

Ap	0 - 6"	Grey (10YR 5/1) clay with few fine yellowish brown mottles; medium, granular structure; slightly plastic; slightly sticky; common fine roots; extremely acid; abrupt smooth boundary.
B1g	6 - 16"	Grey (5Y 6/1) clay with many, fine, strong brown and few, fine, brownish yellow mottles; weak, medium to fine, subangular blocky structure; plastic and sticky; extremely acid; clear, smooth boundary.
B2g	16 - 31"	Grey (5Y 6/1) clay with many fine, brownish yellow and common, fine, yellow mottles; many fine yellowish red mottles in old root channels; weak, medium, subangular blocky structure; plastic and sticky; extremely acid; clear, smooth boundary.
C1g	31 - 42"	Greenish grey (5GY 6/1) clay; common, fine, light yellowish brown to yellowish red mottles; massive to weak, medium subangular blocky structure; plastic and sticky;mildly alkaline; gradual smooth boundary.
C2g	42 - 50"	Greenish grey (5G 6/1) clay; few fine strong brown and light yellowish brown mottles; massive structure; sticky, non plastic; moderately alkaline.

Type Location: About one (1) mile west of the Corentyne River, near Crabwood Creek.

Range in Characteristics: In a few places salts are present in the subsoil or substratum.

Competing Series and their Differentiae: Skeldon soils are more acid than Whittaker soils (37) in the upper horizons, and are more free from salts. The B horizon is more acid and more firm than that in the Corentyne soils (11). The soils have softer consistence and are more fertile than the Everton soils (31a) and the De Velde soils (1).

Setting: Skeldon soils developed in fine-textured marine sediments, in level areas near the coast.

Principal Associated Soils: Plegt Anker (5), Everton (31a), Brandwagt (32a) or Whittaker (37) soils adjoin many areas of Skeldon soils on the side next to the river. On the opposite side in most places are Corentyne soils (11).

Drainage and Permeability: Poorly drained; probably moderately permeable.

Vegetation and Use: Native vegetation is water-tolerant forest. The soil is very easy to drain and is moderately fertile. It is well suited for rice, sugar cane, ground provisions and vegetables. Land-capability subclass Im.

Distribution and Extent: Skeldon soils occupy nearly 15,000 acres near the coast in Berbice County. A smaller acreage probably lies in the parts of the coastal plain not yet covered by semi-detailed soil surveys.

Series Established: Soil Survey of the Canje Area, 1963.

Remarks: None.

Source: Soil Survey of the Canje Area, preliminary report, 1964. Arranged in this form by J. G. Steele, November, 1965.

Stewartville Series, 23

Stewartville clay, map symbol 23, was mapped and named in the Soil Survey of Canal Polder No. 2. by Robert Pariag and Clyde C. Applewhite, June, 1964.

The soil resembles Mara clay (21) except that it contains pockets, largo chunks or in some places horizons of partly decomposed organic matter. In this area the soil also appeared to produce somewhat better crops, when drained and cultivated, than Mara clay.

The soil characteristics described do not appear to justify a separate soil series, the soil is combined with the Mara Series, but if it occurs in mappable areas it should be mapped and named as a phase of Mara soils.

Tabela Series 800

Soils of the Tabela series are classified as members of an acid family of Ultic Quartzipsamments, and as Regosols, excessively drained. The surface soil is brown sand, and the subsoil is strong brown to yellowish red sand or loamy sand that is loose when dry.

Typifying Pedon: Representative profile of Tabela sand.

A1	0 - 8"	Brown (10YR 4/3) fine sand; weak fine crumb structure; nearly loose when dry; many fine grass roots; very strongly acid; gradual smooth boundary. A thin layer of coarse sand is present on the surface between the clumps of grass.
C1	8 - 20"	Strong brown (7.5YR 5/6) loamy fine sand; single grain structure; slightly coherent when moist, loose when dry; very few fine roots; extremely acid; diffuse boundary.
C2	20 - 36"	Strong brown (7.5YR 5/6) loamy fine sand; very weak granular to massive structure; very friable; loose when dry; no roots; extremely acid; diffuse boundary.
C3	36 - 48"	Yellowish red (5YR 5/6) loamy fine sand; very weak granular to massive structure; very friable; loose when dry; extremely acid.

Type Location: The representative profile was described and sampled about 7¼ miles northeast of Ituni River crossing.

Range in Characteristics: In some places there is a thin surface horizon, one half to one inch thick, of bleached coarse sand. Colour of the surface soil ranges from brown to dark greyish brown. Colour of the subsoil ranges from brown to yellowish brown or yellowish red; texture of the subsoil is sand or loamy sand.

Competing Series and their Differentiae: Tabela soils have browner surface soil and subsoil than Tiwiwid sand (700). They have coarser texture in both surface soil and subsoil than Kasarama (810) soils. They have darker coloured surface soil and their subsoil is not so grey as that of Henrietta (730) or Siparuta (732) soils.

Setting: Tabela soils are on undulating or gently sloping relief in sands of the Berbice formation. They are nowhere level, but the slope in many places is less than 3 percent. Slopes between 15 and 25 percent, and in a few places up to 50 percent, are along the valleys of some streams.

Principal Associated Soils: Tiwiwid soils occupy associated areas of white sand. Tabela soils merge into the slightly heavier textured Kasarama soils, and in many places the boundary is somewhat difficult to determine. Henrietta soils and other darker coloured soils are in the drainageways and low places.

Drainage and Permeability: Excessively drained, very rapidly permeable.

Vegetation and Use: Native vegetation is dry savannah in some places, but forest occupies most of the area. The most common type of forest is dry evergreen forest with wallaba, ituri, dakama and other trees. The soils are extremely acid, extremely low in natural fertility, and have very low water-holding capacity. They are poorly suited for annual crops and pastures; pastures can be established and made productive with heavy fertilization, but without irrigation will fail in some dry seasons. Plantings of some timber trees, particularly wallaba or caribbean pine might be successful. Citrus trees probably could be grown with fertilizer and irrigation. Capability class III.

Distribution and Extent: Tabela soils are prominent in the associations of brown sandy soils that occupy about 6,850 square miles, mostly in northeastern, central and southern British Guiana.

Series Established: Soil Survey, Ebini-Ituni-Kwakwani Area, 1963; released in preliminary form 1964.

Remarks: Tabela soils are only slightly better, with respect to agricultural potential, than the white Tiwiwid soils. Soil scientists and others should avoid the generalization that all the "brown sand" soils are capable of producing crops. Forested Tabela soils as a rule should not be cleared since they probably will produce more if left in trees.

Source: Soil Survey, Ebini-Ituri-Kwakwani Area, preliminary release May, 1964. Compiled in this form by J. G. Steele, December, 1965.

Tain Series, 9

Soils of the Tain series are members of a fine silty or clayey, non-acid family of Aquic Haplorthents. They are also classified as Low Humic Gley soils, poorly drained. They consist of grey mottled clay that is firm to a depth of 30 inches. The substratum is soft grey or greenish grey clay.

Typifying Pedon: Typical profile of Tain clay, under bisi bisi vegetation.

A1	0 - 6"	Grey (5Y 5/1) clay with common, medium prominent yellowish brown and dark yellowish brown mottles; massive structure; firm, sticky and plastic; many fine fibrous roots; medium acid; gradual wavy boundary.
C1g	6 - 30"	Grey (5Y 5/1) clay with common, medium prominent yellowish brown and reddish brown mottles; massive structure; firm, sticky and plastic; occasional roots; neutral; gradual wavy boundary.
C2g	30 - 46"	Grey (5Y 6/1) clay, with common, medium, prominent dark brown mottles; massive structure; sticky and plastic; mildly alkaline; gradual wavy boundary.
C3g	46 - 54"+	Grey (5Y 5/1) clay with common, medium, prominent, dark brown mottles; massive structure; sticky and plastic but much softer than the horizon above, moderately alkaline.

Type Location: On Port Mourant Race Course, about 1½ miles from the coast, Berbice County, British Guiana.

Range in Characteristics: Colour of the surface soil is grey or dark grey. The surface soil generally is non-saline. Mottling in the subsoil ranges from dark yellowish brown or strong brown to reddish brown. The base colour in some places is greenish grey. Depth to the underlying soft clay ranges from 18 to 48 inches.

Competing Series and their Differentiae: Tain soils have more red mottling than the saline phase of De Velde soils (1a). They lack the yellowish red concretions that are in Whittaker soils (37) and the yellowish mottles of the Haswell soils (25). They are more poorly drained and finer textured than Ithaca soils (72) and Whim soils (75). They are more saline, have darker mottling, and are less acid and firm than Skeldon soils (13).

Setting: Tain soils are near the coast, in areas recently flooded with salty or brackish water. The firm clay is presumed to be recent alluvial sediments, and the underlying soft clay is of marine origin.

Principal Associated Soils: Tidal flats (T) De Velde soils (1) in silty or clayey alluvium, Ithaca (72) and Whim (75) soils on ridges, and Skeldon (13) Whittaker (37), and Haswell (25) soils in fine textured marine sediments.

Drainage and Permeability: Poorly drained, very slowly permeable. Surface run-off is very slow.

Vegetation and Use: Vegetation on the site samples was bisi bisi. Drainage and leaching of salt are essential before crops can be grown. Then the soil is well suited for rice, moderately well suited for sugar cane and pasture, and poorly suited for most other crops. Land capability subclass IIs.

Distribution and Extent: Extent in the Canje Area, British Guiana, is 7,220 acres. Not mapped in the Mahaica-Mahaicony-Abary Area. Further extent probably is not great.

Series Established: Soil Survey of the Canje Area, 1963.

Remarks: None.

Source: Soil Survey, Canje Area, preliminary release 1964. Arranged in this form by J.G. Steele, November, 1965.

Takama Series, 710

The Takama series, described in the Soil Survey of the Ebini-Ituni-Kwakwani Area (1964) is identical with the Kasarama series (810) except for slightly lighter colour. It was combined with the Kasarama series in 1965.

Tarakuli Series, 702

Soils of the Tarakuli series are classified as members of an acid family of Umbric Quartzipsamments; and as Regosols (with a thick Al horizon), excessively drained. They have a thick very dark drey to black surface layer over loose, white or pale brown sand or loamy sand.

Typifying Pedon: Representative profile of Tarakuli sand.

Al	0 - 6"	Very dark grey (10YR 3/1) medium sand; weak fine granular structure; loose; numerous fine and medium size roots; numerous white sand grains; extremely acid; clear, smooth boundary.
A12	6 - 14"	Very dark greyish brown (10YR 3/2) medium sand containing a few coarse sand grains; single grain structure; loose; numerous fine and few medium roots; occasional white sand grains; extremely acid; gradual, smooth boundary.
C1	14 - 23"	Dark grey (10YR 4/1) grading to grey (10YR 5/1) sand with few coarse sand grains; single grain structure; loose; few fine and occasional medium roots; occasional piece of charcoal; extremely acid; gradual, smooth boundary.
C2	23 - 48"	Light grey to white (10YR 7/1 - 8/2) sand; content of fine sand higher than in the horizon above; some coarse sand grains; single grain structure; loose; few fine roots; extremely acid.

Type Location: The representative profile was described and sampled near Atkinson Airfield, East of the Demerara River.

Range in Characteristics: Thickness of the Al horizon ranges from 10 to more than 30 inches; colour of the Al horizon, from black or very dary grey to very dark greyish brown. Colour of the subsoil ranges from white to pale brown; texture of the subsoil is sand or loamy sand.

Competing Series and their Differentiae: Tarakuli soils have a thicker dark Al horizon than Tiwiwid soils. They are less wet than Ituni soils, and do not have the dark coloured cemented layer in the subsoil. They are more sandy and have much more rapid natural drainage than Henrietta (730) or Siparuta (732) soils.

Principal Associated Soils: Associated soils are mainly those of the Tiwiwid (700), Tabela (800) and Ituni (701) series.

Drainage and Permeability: Excessively drained, very rapidly permeable.

Vegetation and Use: Native vegetation is evergreen forest. The soil is very strongly acid; very low in plant nutrients, and droughty. Although tomatoes, leafy vegetables, peanuts, tobacco, or pineapples might be grown, other soils in the same locality are better for those crops. Forest plantings of caribbean pine or of wallaba might be successful. Land capability subclass IIIf.

Distribution and Extent: Tarakuli soils occupy a small acreage in the gently sloping areas of white sand.

<u>Series Established</u>: Soil Survey, Canje Area, 1963.

<u>Remarks</u>: None.

<u>Source</u>: Compiled from soil survey of Canje Area, preliminary release 1964. Arranged in this form by J.G. Steele, December, 1965.

Tiger Creek Series

In the Tiger Creek series are soils classified tentatively as Typic Udorthox, members of a sandy skeletal family; and as gravelly Regosols grading to brown latosols. They are well drained. The surfaoe soil ranges from very gravelly loamy sand to very gravelly clay. Beneath about 24 inches is olay to sandy clay loam that contains hard fragments or massive laterite.

Typifying Pedon: Profile of Tiger Creek gravelly loamy sand.

A11	0 - 2"	A mixture of coarse sand with medium and fine gravel. Dark brown (7.5YR 3/2). Some of the gravels are black or very dark brown. Much of the sand and some of the fine gravel is white quartz. Many fine and few medium roots. pH 4.2. A few fragments of ironstone 1 to 3 inches in diameter are on the surfaoe.
A12	2 - 8"	Very gravelly loamy sand. Fine fraction is loamy sand, dark yellowish brown (10YR 3/4). Pieces of gravel 2-10 mm in diameter are mostly iron pellets. Sand contains many white grains of quartz. No discernible soil structure (single grain). Fine roots common. pH 4.2. Boundary smooth, clear, but contrast with next horizon is slight.
B1	8 - 13"	Dark yellowish brown (10YR 4/4) mixture of gravel and loamy sand. No discernible structure (single grain). Common fine roots. Few medium pores. Boundary clear, smooth, but contrast is not great.
B2	13 - 25"	Brown (7.5YR 4/4) mixture of gravel and sandy loam. No discernible structure. Fine roots common. pH 4.2. Boundary clear, smooth.
C1	25 - 34"	Strong brown (7.5YR 5/8) mixture of gravel and sandy clay loam. Gravel is mostly fragments of ironstone, some 25mm long. Fine roots common.
C2	34 - 51"	Strong brown (7.5YR 5/8) mixture of ironstone gravel and sandy clay loam. Many of the gravel fragments oan be cut or broken to expose red interiors.

Below about 65 inches (auger boring in bottom of pit) the soil material is sandy clay, apparently weathered rock (granite), that contains fewer hard fragments than the horizon above.

Type Looation: The representative profile was described and sampled along Dickman's trail near Mahdia, about one-half mile from the road.

Range in Charaoteristios: Matrix material in the gravelly soil in some places is sandy. Below 24 inches in some places is massive laterite.

Competing Series and their Differentiae: The soils are more gravelly than those of the Hosororo series (340).

Setting: Tiger Creek soils are on benches that are underlain partly by basic igneous rocks. Lateritic ironstone and ironstone gravel are abundant. The soils are on the benches and levels between 400 feet and 500 feet in Mahdia Valley, on the tops of gently sloping hills, and on upper bench slopes to just below the 350 feet contour line.

Principal Associated Soils: Hosororo soils are on higher slopes. Soils resembling those of the Wauna series are on some ridges in the vicinity of Mahdia.

Drainage and Permeability: Well drained and moderately permeable except where underlain by massive laterite.

Vegetation and Use: Native vegetation is rain forest. Probably suitable for cultivation if slope is favourable, but the matrix material in the gravelly soil is easily washed away.

Distribution and Extent: Not known in 1965.

Series Established: Mahdia Valley, 1959.

Remarks: This description was taken mostly from the published Soil Survey of Mahdia Valley. It is subject to correction if errors have been made in adopting the description or in classifying the soil. The representative profile was described by H.N. Ramdin and J.G. Steele in March, 1966. Items lacking in the description need to be filled in after field studies.

Source: Soil and Land Use Surveys No. 5, British Guiana, Imperial College of Tropical Agriculture, April, 1959. Compiled in this form by J.G. Steele, April, 1966.

Tin Creek Series

Tin Creek soils were named and mapped in the Soil Survey of the Mahdia Valley, by J. Stark and others published 1959. Study of the description in 1965-66 suggests that the soils are within the range now proposed for the Hosororo series, and in future soils surveys might be named as steep or rocky phases of Hosororo soils. This recommendation will need to be tested when further soil surveys are made in areas of basic rocks.

Tirke Series

The Tirke soils are members of a deep, coarse loamy family of Plinthic Normudults. They are also classified as Red-Yellow Podzolic soils grading to Ground-Water Laterite, and are moderately well drained. They are on fans along the Annai-Good Hope mountain front. They consist of loamy sand over sandy loam to sandy clay loam which contains common, coarse, brittle, red concretions.

Typifying Pedon: Profile of Tirke loamy sand.

0 - 3"	(10YR 4/1) dark grey loamy fine sand; loose; structureless; common roots.
2 - 24"	(10YR 6/3) pale brown loamy sand; structureless.
14 - 48"	(10YR 6/2) light brownish grey sandy loam to sandy clay loam; structureless; common, coarse, brittle red concretions; common fine faint orange mottling.

Type Location: Fans along the foot of the Annai-Good Hope mountain front near the northern edge of the Rupununi Savannahs in south-western British Guiana.

Range in Characteristics: Not available in 1965.

Competing Series and their Differentiae: The extent of this series, its range in characteristics, and the differentia from competing series all need to be established after field studies.

Setting: The soils are on hill-wash fans at the foot of the mountains where moisture is favourable.

Principal Associated Soils: Lithosols on the mountains, and Benoni and Cachoeira soils on the lacustrine plain to the south.

Drainage and Permeability: The description suggests that the soils are moderately well drained and moderately permeable.

Vegetation and Use: Vegetation on the site described was trees and grass, Curatella americana and Trachypogon plumosus. According to the soil survey report, "Of all the soils in the Northern Savannahs this series carried the greatest acreage under cultivation. Near Annai and Tirke, tobacco, corn and ground provisions are grown. The apparently higher fertility of the soil is undoubtedly due to the favourable moisture regime within the fan deposits attributable to seepage from the mountains. Tirke series is, however, of limited extent, but could be used for fertilised pastures in addition to the present land use."

Distribution and Extent: Tirke soils occupy 17 square miles in the area covered by soil surveys. Extent on other hill-wash fan deposits in the savannahs will need to be determined.

Series Established: Soil Survey of the Rupununi Savannahs (continued), published June 1959.

Remarks: Field studies are needed to find out the validity of this series and its extent. Suggett and Braun described a reddish brown lateritic soil on mountain pediments (their Unit Mp) but did not show any mappable areas of Mp at the foot of the mountain between Good Hope and Annai. Their description of the farming at the foot of the Kanuka mountains is similar to the one by Stark and others of that on the Tirke soils. The description of Tirke soils, however, does not suggest the Reddish Brown Lateritic great group. The sample of Tirke soil was acid, but less so than the usual Red-Yellow Podzolic soil in British Guiana. The classification and extent of the soils can be determined only after further field studies.

Source: Compiled from Soil and Land Use Surveys No. 6, British Guiana, Regional Research Centre at I.C.T.A., Trinidad, W.I., June 1959. Arranged in this form by J.G. Steele, 1966.

Tiwiwid Series, 700

Soils of the Tiwiwid series are classified as members of an acid family of Typic Quartzipsamments, and as Regosols, excessively drained. The surface soil is grey to very dark grey sand, depending on the amount of organic matter. Beneath the surface layer is loose white or light brownish grey sand or loamy sand.

Typifying Pedon: Representative profile of Tiwiwid sand.

A1	0 - 4"	Very dark greyish brown (10YR 3/2) sand; single grain structure; loose; many fine and medium roots; extremely acid; clear boundary.
A3	4 - 7"	Greyish brown (10YR 5/2) fine sand; single grain structure; loose; many fine and medium roots; extremely acid; gradual smooth boundary.
C1	7 - 14"	White (10YR 8/2) fine sand; single grain structure; loose; few charcoal specks in old root channels; extremely acid, gradual smooth boundary.
C2	14 - 34"	White (10YR 8/2) coarse sand; single grain structure; loose; few charcoal specks in old root channels; few medium roots; extremely acid; diffuse boundary.
C3	34"	White (10YR 8/1) coarse sand; single grain structure; loose; extremely acid.

Type Location: Near river crossing, about 11 miles east of Ituni, in British Guiana.

Range in Characteristics: Colour of the surface soil ranges from nearly white or pinkish white to very dark greyish brown or dark grey. Colour of the subsoil is white to light yellowish brown. Texture of the subsoil is sand or loamy sand. Grain size of the sand ranges from fine to coarse.

Competing Series and their Differentiae: Colour of the subsoil is white to light yellowish brown, lighter than that of Tabela (800) soils. Texture is coarser, especially in the subsoil, than that of Kasarama (810) soils. Tiwiwid soils lack the thick, dark coloured A1 horizon of the Tarakuli soils (702).

Setting: Tiwiwid soils consist of coarse textured sediments of the Berbice formation on uplands, colluvial positions, and creek slopes. The substratum in some places is deep white sand; in other places the white sand is underlain by brown sand, loamy sand, or finer textured material.

Principal Associated Soils: Tiwiwid soils in many places occupy higher parts of the landscape, in association with Ituni (701), Tabela (800), Kasarama (810), and other soils.

Drainage and Permeability: Excessively drained, very rapidly permeable.

Vegetation and Use: Vegetation in some places is scrub trees, largely muri bush, and sparse savannah grasses and other plants. Elsewhere, the forests contain large trees, including greenheart and wallaba. Forests recover slowly after a fire. Plantings of Caribbean pine have grown rapidly at several places south of Bartica. Probably a layer of fine sand or finer texture in the subsoil or substratum improves the site quality for forest trees. Cashew trees, pineapples, and some other economic plants grow with fair success in some places, but the soil is not suitable for cultivation. Capability class IV, except where local site factors permit use Class III.

Distribution and Extent: Tiwiwid sand is the dominant soil in 6,500 square miles, mostly in north-eastern British Guiana, although scattered spots lie in the northwestern section from the Essequibo River to the vicinity of the upper Waini River. Tiwiwid soils also occur in the soil associations that are dominated by brown sandy soils of the Tabela (800) and related series.

Series Established: Soil Survey of the Bartica Triangle, published 1959.

Remarks: Authors of the Soil Survey, Ebini-Ituni-Kwakwani Area, appeared reluctant to write that Tiwiwid soils are not suitable for cultivation. Although pineapples grow wild or semi-wild, and cashews and other trees appear to do fairly well in some home grounds and village compounds, the responses of crops on other soils are so much better that any suggestion for more than occasional cultivation of Tiwiwid soils appears futile.

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary release 1964. Compiled in this form by J.G. Steele, December, 1965.

Torani Series, 153

In the Torani series are soils classified as Ochric Plinthaquults, members of a fine silty, moderately permeable family (poorly drained, Ground-Water Laterite). They have a greyish brown surface soil, light brownish grey subsurface soil, grey mottled upper subsoil, and grey silty clay lower subsoil that contain prominent, medium to large, red mottles and some soft iron concretions.

Typical Profile of Torani Silt Loam, Forested:

A1	0 - 7"	Greyish brown (10YR 5/2) silt loam, with common, medium, prominent dark red mottles; medium and fine granular structure; friable; slightly plastic; common fine and medium roots; very strongly acid; clear, smooth boundary.
B2g	7 - 18"	Grey (5Y 6/1) silt loam, with many, medium, prominent yellowish brown and reddish yellow mottles; medium subangular blocky structure; friable; slightly plastic; few fine roots; extremely acid; clear, smooth boundary.
B3g	18 - 36"	Grey (5Y 6/1) silty clay loam with many, medium, prominent red and brownish yellow mottles; medium and coarse subangular blocky; firm; slightly sticky and slightly plastic; extremely acid; gradual, wavy boundary.
C1g	36 - 45"	Grey (5Y 6/1) silt loam with few, fine prominent dark red mottles; massive structure; friable; slightly plastic; extremely acid; clear, smooth boundary.
C2g	45 - 60"+	Grey (5Y 6/1) silty clay loam with common, medium, prominent dark red and brownish yellow mottles; fine subangular blocky structure; slightly sticky, slightly plastic; extremely acid.

Type Location: 1½ mile north of Torani Canal and 2 miles west of Canje River, Berbice County, British Guiana.

Range in Characteristics: Colour of the A horizon ranges from dark greyish brown to light brownish grey. Mottling in the upper B horizon is predominantly brownish; in the lower B horizon, yellowish red and dark red. The dark red mottles are firm or very firm, and they harden on exposure to air. Texture of the B horizon ranges from silty clay loam to silty clay. The substratum is marine clay in some places. Colours given are for moist soil. If the soil dries, colour values are one or two units higher.

Competing Series and their Differentiae: Torani soils are more poorly drained and more mottled than Potoco (157) soils, and they are better drained (less wet) than Putkin (156) soils. The depth to reticulate red mottles is less than in the Potoco soils. Red mottles in the lower subsoil are more prominent than in Helvetia soils (152). They lack the fragipan that is present in Kamani soils (53) and the surface soil contains less organic matter than that of the Putkin soils (156).

Setting: Torani soils developed under forest cover in nearly level or very gently sloping silty sediments on old terraces of the Coropina geological formation. The substratum is silty clay loam, silty clay, or in some places, marine clay.

Principal Associated Soils: Soils of the Yesi (150), Potoco (157), Cola (152) and Putkin (156) series differ in colour or in natural drainage as described. De Velde (1) and Mara (21) soils are associated in some places. De Velde soils lack developed horizons and red mottling; Mara soils are low, wet and soft; and contain acid sulphates.

Drainage and Permeability: Poorly drained; surface run-off and internal drainage are slow. Permeability is moderate.

Vegetation and Use: Native vegetation is tropical rain forest that includes kokerite palm (Maximiliana regia), kakarali (Eschweilers sp), mora (excelsa), wild plantain (Heliconia psittacorum), wild starch (Thalia geniculata) and razor grass (Lagenocarpus guianensis). A large part is in forest. Cleared areas are used for pasture and for bananas, plantains, coconuts and ground provisions. Shifting cultivation is common. Crops respond well to drainage and probably to fertilizer, although experience is lacking. The level of natural soil fertility is very low. Land-capability subclass IIf.

Distribution and Extent: On silty sediments of the Coropina formation, in coastal plain near the margin of the more sloping sandy soils, between the Demerara and the Corentyne Rivers in British Guiana. Similar soils have also been observed on stream terraces in the interior of British Guiana.

Series Established: Soil Survey of Canje Area, British Guiana, 1963.

Remarks: Formerly named the Bartica series, after Bartica Creek near Torani. Changed to Torani in 1966, since the soils do not occur near the well-known town of Bartica.

Sources: Described by Glenn H. Robinson, November 1963. Arranged in this form by J.G. Steele, July 1965.

Tuschen Series, 39

The Tuschen series consists of soils classified as Aquic Haplorthents, members of a family of these soils that are fine silty or clayey, and moderately deep over soft, sulphate clay (poorly drained, Low Humic Gley). They have a thin dark grey surface soil, a grey or greenish grey subsoil, mottled with brownish yellow, yellowish red, or brown, and below 36 to 60 inches, a substratum of soft clay that contains pieces of organic matter and in many places, acid sulphates.

Typifying Pedon: Representative profile of Tuschen clay, near corner of Parkinsons dam and Georgia dam, about 3½ miles north of the mouth of Kamuni Creek, West Bank of Demerara River.

A1	0 - 1"	Dark grey (10YR 4/1) silty clay; weak subangular blocky structure; sticky and plastic; fine roots are common, some partially decomposed and raw plant material embedded on the surface; very strongly acid; abrupt, smooth boundary.
A3	1 - 5"	Dark grey (10YR 4/1) clay; mottles of yellowish red (5YR 4/6) are few, fine and prominent and occur along old root channels; weak, subangular blocky structure, firm; plastic and sticky; few fine and occasional medium roots; very strongly acid; clear wavy boundary.
B1	5 - 10"	Grey (10YR 5/1) silty clay; mottles of yellowish red (5YR 4/8) are few, fine and prominent and occur along old root channels; weak subangular blocky structure; firm; plastic and sticky; few fine and occasional medium roots; very strongly acid; clear wavy boundary.
B21g	10 - 25"	Grey (10Y 5/1) clay; mottles of brownish yellow (10YR 6/8) yellowish red (5YR 4/6), strong brown (7.5YR 5/8) are common, medium and prominent (some mottles appear as aggregates and some occur along root channels), massive structure; firm; sticky and plastic; few fine and medium roots; very strongly acid; gradual smooth boundary.
B22g	25 - 34"	Grey (5Y 6/1) clay with common, medium and prominent mottles of yellowish red (5YR 4/6) brownish yellow (10YR 6/8) and strong brown (7.5YR 5/8) (some mottles appear as aggregates); massive structure; firm; plastic and sticky; few fine roots; strongly acid; gradual smooth boundary.
B3g	34 - 41"	Light brownish grey (10YR 6/2) clay; mottles of strong brown (7.5YR 5/8) are few; medium and distinct and occur along old root channels; massive structure; plastic and sticky; few fine roots; strongly acid; clear smooth boundary.
C1g	41 - 54"	Grey to dark greenish grey (5Y 4/1 - 5GY 4/1) clay; massive structure; plastic and sticky; many pieces of organic matter in various stages of decomposition, medium acid.

Type Location: About 3½ miles north of the mouth of Kamuni Creek, West Bank Demerara River.

Range in Characteristics: In some places the soil over the soft clay is silty or contains lenses or strata of silt. Colour of the surface soil is dark grey or very dark grey. Mottles in the B horizon range from strong brown to reddish yellow. Depth to the soft, greenish grey clay ranges from 36 to 60 inches. In many profiles the contact is visible as a thin horizon of slightly darker clay. The alluvial clay or silt is strongly or very strongly acid. Reaction in the lower substratum, when it is wet and in place, ranges from pH 6.5 to 8.0. This material turns strongly acid on drying. Thickness of peat on the surface ranges from 0 to 12 inches.

Competing Series and their Differentiae: Tuschen soils have a B horizon that is somewhat developed (somewhat firm, and contains mottles of segregated iron oxides) but less so than that of the Everton soils (31a). They are more subject to flooding than the Everton soils. The depth to soft, greenish grey clay is 36 to 60 inches, which is greater than in Brickery soils (36).

Setting: Tuschen soils are on natural levees of the streams, slightly lower than areas of Everton (31a) or De Velde (1) soils, and on margins of the main swamps that are of marine origin. They are developed in fine textured alluvium over old marine sediments that are similar to Mara clay.

Principal Associated Soils: Everton soils (31a) De Velde clay (1c) and De Velde silt loam (1s) are in slightly higher places on the natural levees. Anira peat (20) and Mara clay (21) are in swamps.

Drainage and Permeability: Poorly drained; slow permeability; slow surface runoff and slow internal drainage.

Vegetation and Use: Native vegetation is tropical rain forest.

Tuschen soils are moderately suited for crops. Efficient drainage, lime, complete fertilizer, and above-average management will produce moderate yields of rice, sugar cane, bananas, plantains or ground provisions. Special care in drainage is needed to prevent toxic sulphates from rising and injuring roots of crops. Land-capability subclass IIf.

Distribution and Extent: Mainly along the lower Demerara and Essequibo Rivers and the creeks that flow into them.

Series Established: Kamuni-Potosi Area, West Bank Demerara, 1964.

Remarks: None.

Sources: H.N. Ramdin, Soil Survey of Kamuni-Potosi Area, 1964. Compiled in this form by J.G. Steele, June 1965 and March 1966.

Vigilante Series, 54

In the Vigilante series are soils classified as Oxic Umbraquults, members of a clayey family (Humic Gley, very poorly drained). Typically, the surface soil is very dark grey silty clay 8 to 20 inches thick. The subsoil is silty clay loam, grey mottled with yellowish brown. A buried horizon of peat is present in some places.

Typical Profile of Vigilante Silty Clay:

A1	0 - 17"	Very dark grey (10YR 3/1) silty clay; weak fine granular structure; slightly sticky, slightly plastic; numerous fine and some medium roots; extremely acid; clear, smooth boundary.
B2g	17 - 25"	Grey (10YR 5/1) clay with common, medium distinct brownish yellow mottles; soil breaks into irregular blocks; slightly sticky, plastic; common fine roots; extremely acid; clear, smooth boundary.
B3g	25 - 31"	Grey (5Y 6/1) silty clay loam with common, medium, distinct yellowish brown mottles; pockets of darker coloured material from the above horizon; soil breaks into irregular blocks; friable, non sticky, non plastic; occasional fine roots; extremely acid; gradual wavy boundary.
C1g	31 - 40"	Grey (5Y 6/1) silt loam with common, medium, prominent yellowish brown mottles; massive structure; very friable; non sticky, non plastic; occasional fine roots; extremely acid; gradual smooth boundary.
C2g	40 - 60"+	Light grey (5Y 7/1) silt with few, medium, prominent strong brown mottles; massive structure; very friable; non sticky, non plastic; extremely acid.

Type Location: 2½ miles north-west of De Velde, near Berbice River, British Guiana.

Range in Characteristics: Thickness of the dark coloured surface soil ranges from 8 to 20 inches. A buried horizon of dark coloured soil or of peat is present in some places.

Competing Series and their Differentiae: Vigilante soils have darker, finer textured surface soil and are wetter than Helvetia (52) Torani (153) or Cola (152) soils. They lack the fragipan that is present in Kamani soils (53).

Setting: Vigilante soils are in depressions under savannah or forest vegetation on the old, silty, alluvial terraces that are known as the Coropina geological formation. The areas are nearly level.

Principal Associated Soils: Associated with better drained soils in similar but less clayey materials, especially of the Helvetia (52), Cola (152), Potoco (157) or Nassau (57) series.

Drainage and Permeability: Vigilante soils are very poorly drained. Surface drainage is very slow or ponded. Permeability is slow or very slow.

Vegetation and Use: Native vegetation is dominantly forest in some places, savannah in others. Aete palm and razor grass are common. The soils are extremely acid and very low in fertility. Drainage would be difficult. With adequate surface drains and large amounts of lime and fertilizer, ground provisions and pineapples might be grown. The soils would be poorly suited for most other crops. Land-capability subclass IIw.

Distribution and Extent: In low places on the silty terraces near the inner margin of the coastal plain in north-eastern British Guiana.

Series Established: Canje Area, 1963.

Remarks: Experience is lacking on performance if crops are planted.

Sources: Described in preliminary soil survey reports of Canje Area, by Robert Brinkman, 1964; and of Ebini-Ituni-Kwakwani Area by Robert Brinkman, 1964. Arranged in this form by J.G. Steele, July, 1965.

Vryberg Series, 34

Soils of the Vryberg series are classified as members of a clayey, slowly permeable family of Typic Ochraquults; also as Low Humic Gley soils, poorly drained. They have a thin, grey or greyish brown surface soil and a very firm, slowly permeable clay subsoil that is grey mottled with red and some yellowish brown.

Typifying Pedon: Representative profile of Vryberg clay.

A1	0 - 4"	Dark grey (10YR 4/1) clay; moderate, medium granular structure; friable, plastic and sticky, numerous roots; extremely acid; gradual smooth boundary.
B1g	4 - 16"	Grey (10YR 5/1) clay with common, medium, distinct brown and some yellowish brown mottles; moderate fine subangular blocky structure; plastic and sticky; numerous roots; considerable penetration of organic material in root channels; extremely acid; clear smooth boundary.
B2g	16 - 36"	Grey (5Y 6/1) clay with common, medium and prominent red and yellowish brown mottles; moderate fine subangular blocky structure; very firm; plastic and sticky; few fine roots; thin clay films; few soft concretions; extremely acid; smooth boundary.
Cg	36 - 58"	Grey (5Y 6/1) clay with many medium to large prominent brownish yellow and some red mottles; very firm; plastic and sticky; extremely acid.

Type Location: The representative profile was described and sampled about 2½ miles east of the Berbice River at Mara in Berbice County.

Range in Characteristics: Colour of the A horizon ranges from very dark grey to dark greyish brown; of the subsoil, from greenish grey to mottled grey and yellowish brown. Hard or soft concretions and lenses of silt are in the C horizon at some places. Reaction of the C horizon ranges from pH 5.0 to 7.0, and texture from clay to silt loam.

Competing Series and their Differentiae: Vryberg soils resemble the Canje soils (31) except for red mottling in the B horizon. They resemble the Bath soils (34a) but are less permeable in the subsoil and are very strongly acid in all horizons of the profile. They are less permeable, more acid, and have stronger soil structure in the B horizon than De Velde soils or the other soils in alluvial sediments that have less distinct horizons.

Setting: Vryberg soils developed in old, fine textured alluvium. They are on old natural levees along streams in the coastal area, and are nearly level but slightly higher than the soils in marine clays.

Principal Associated Soils: Canje (31), Everton (31a) and Bath (34a) soils lie in similar positions. Kerkenama (32) and Brandwagt (32a) soils are in depressions.

Drainage and Permeability: Poorly drained, slowly permeable and difficult to drain artificially.

Vegetation and Use: Native vegetation is tropical rain forest. The soils are well suited or moderately well suited for most crops, but less so for coconuts and some root crops. The soils are acid and are only moderately well supplied with calcium, potassium and phosphorus. Lime and complete fertilizer are essential to maintain good yields. Capability subclass IIm.

Distribution and Extent: About 75 square miles have been mapped. The unmapped area probably is much smaller. Main areas are on old natural levees near the Canje River and the Mahaicony River.

Series Established: Mahaica-Mahaicony-Abary Area, 1962.

Remarks: None.

Source: Soil Surveys, Canje Area and Mahaica-Mahaicony-Abary Area, preliminary release, 1964. Compiled in this form by J.G. Steele, November, 1965.

Waruma Series

Soils of the Waruma series are classified as Ultic Aquipsamments, members of a non-acid family; and as Low Humic Gley soils, poorly drained. They consist of an overwash of sand over pale olive clay.

Typical Profile of Waruma Sand:

0 - 3"	(10YR 5/1) grey loamy fine sand with much humus; structureless; roots frequent.
3 - 18"	(10YR 8/0) white medium sand; soft; structureless; few roots.
18 - 19"	Irregular layer of dark grey humic fine sand.
19 - 44"	(5Y 6/3) pale olive clay; friable; few roots; frequent greenish deposits along root channels; common soft large yellow concretions.

Type Location: Rupununi Savannahs in south-western British Guiana.

Range in Characteristics: Not defined in descriptions available in October, 1965. In some places a stone line lies between the sand and the clay.

Competing Series and their Differentiae: The location in low wet places and the sandy overwash about 20 inches thick distinguish Waruma soils from Kaput soils on adjacent slopes. Waruma soils lie mostly in small areas; Makushi soils and Dead Man Swamp soils lie in larger wet flats.

Setting: Waruma soils are in bottoms and depressions where colluvial sand has been deposited over material similar to that which forms the Kaput soils.

Principal Associated Soils: Most areas are in a mapping unit named as the Kaput-Waruma association. Separate areas were mapped in bottoms next to Sawariwau soils.

Drainage and Permeability: Very poorly drained; slowly or very slowly permeable.

Vegetation and Use: Vegetation is savannah grasses and scattered shrubs. Used for grazing.

Distribution and Extent: Areas of Waruma soils within the Kaput-Waruma association were estimated to be about 54 square miles. Only 1½ square miles were in mappable bodies in the area covered by the soil survey. Further extent of the Waruma soils is not known in 1965.

Series Established: Soil Survey of Rupununi Savannahs, published 1958.

Remarks: Chemical characteristics are described as similar to those of soils in the Long Man Swamp series. The possibility of correlation as an overwash phase of Long Man Swamp soil should be considered.

Sources: Named and described in soil and land use survey No. 2, British Guiana, The Rupununi Savannahs, by R.F. Loxton, T.A. Jones and others, Regional Research Centre at I.C.T.A., Trinidad, March 1958. Assembled in this form by J.G. Steele, October, 1965.

Wauna Series, 350

The Wauna series consists of soils classified as Oxic Normudults, members of a moderately deep or deep, isothermal family (well drained Red-Yellow Podzolic soils). Wauna soils typically have a surface layer of dark brown or very dark greyish brown sandy loam or sandy clay loam that contains a noticeable amount of coarse sand, a subsoil of reddish yellow gritty clay, and a substratum of weathered granite or other acidic rock that is red gritty clay somewhat mottled with reddish yellow.

Typical Profile of Wauna Sandy Loam, Wauna Pilot Settlement:

A1	0 - 3"	Very dark greyish brown (10YR 3/2) loamy sand; weak medium granular structure; friable; fine roots are abundant, medium roots are few; extremely acid; clear, smooth boundary.
A3	3 - 18"	Dark greyish brown (10YR 4/2) sandy clay loam; weak medium granular structure; friable; fine roots are common, medium roots are few; bits of charcoal occur at 12 inches; fine quartz grains scattered throughout; very strongly acid; smooth, wavy boundary.
B21	18 - 27"	Yellowish brown (10YR 5/6) sandy clay loam, mottles of yellowish red (5YR 5/8) are few, medium and distinct; medium granular structure; friable; fine roots are common, medium roots are few; fine quartz grains are common; very strongly acid; clear, smooth boundary.
B22	27 - 36"	Reddish yellow (7.5YR 6/6) sandy clay; mottles of strong brown (7.5YR 5/8) are few, medium and faint, medium granular structure; friable; slightly plastic and non sticky; scattered coarse quartz grains; very strongly acid; clear smooth boundary.
C1	36 - 43"	Yellowish red (5YR 5/8) sandy clay; massive structure but individual clods break into irregular blocks; slightly plastic and slightly sticky; scattered quartz grains; few bits of gravel varying in size from 1 to 3 cm; very strongly acid; clear smooth boundary.
C2	43 - 49"	Light red (2.5YR 6/8) clay; mottles of brownish yellow (10YR 6/8) are common, medium and prominent; massive structure; plastic and slightly sticky; coarse quartz grains are common; few bits of gravel varying in size from 1 to 3 cm; very strongly acid.

Type Location: Along new road near Field Assistant's house, Wauna Settlement.

Range in Characteristics: Colour of surface soil ranges from brown to dark greyish brown; colour of subsoil from yellowish brown to reddish yellow. Boulders of soft, weathered granite, from a few inches to more than one foot in diameter, are common in the soil. In some places bedrock lies within 4 feet of the surface. Some of the weathered granite apparently has been cemented, probably by iron compounds.

Competing Series and their Differentiae: The subsoil is more red and the surface soil is thinner and not so dark coloured as in the somewhat poorly drained soil that lies on adjacent lower slopes. Distinctions from the Mahdia and the Durban series need to be established.

Setting: Wauna soils are on uplands of granitic or other acidic rocks, in residual and probably partly in colluvial materials. Slopes range from about 4 percent to more than 30 percent.

Principal Associated Soils: A somewhat poorly drained soil, with thicker dark surface soil, on lower slopes. Muck, and possibly also a dark coloured, poorly drained sandy soil, in low places.

Drainage and Permeability: Well drained; probably moderately permeable.

Vegetation and Use: Native vegetation is rain forest consisting of mora, kakarali, krokai, kakubali, kunta, whitee, trysil, bara bara, yarula and other trees. Capability subclass of A and B slopes, IIf.

Distribution and Extent: Probably extensive in areas of granitic rocks, gneiss, etc. in north-west British Guiana.

Series Established: Wauna-Yarakita Area, 1964.

Remarks: The range of characteristics needs to be confirmed and placed in this record.

Sources: Soil Survey, Wauna-Yarakita Area, by Harold N. Ramdin and Clyde C. Applewhite, 1964. Observations were also made by Harold N. Ramdin and J.G. Steele, 4-11 May 1965. This description arranged by J.G. Steele, July, 1965 and amended in 1966.

Weldaad Series, 44

Soils of the Weldaad series are classified as members of a clayey, acid, soft or moderately firm family of Aquic Haplorthents; also as Humic Gley soils, very poorly drained. They are in depressions. The surface soil, about 10 inches thick, is very dark grey. The upper subsoil is very dark grey. The upper subsoil is clay, grey mottled with reddish brown and brownish yellow. The deeper subsoil is soft grey clay that in some places contains acid sulphates.

Typifying Pedon: Profile of Weldaad clay.

Ap	0 - 10"	Very dark grey (10YR 3/1), (10YR 6/1) dry silty clay mottled with brownish yellow and yellowish brown along root channels; mottles are common, medium and faint; medium to fine subangular blocky structure; firm slightly sticky, plastic; fine roots are common, extremely acid; clear, smooth boundary.
C1g	10 - 20"	Grey (5Y 6/1) clay mottled with dark reddish brown and brownish yellow; mottles are common, medium and prominent, occurring as a soft concretionary infilling of old root channels, and on the faces of some fragments; massive; firm, sticky, plastic; few old root channels; extremely acid; gradual, wavy boundary.
C2g	20 - 46"	Grey (5Y 6/1) clay mottled as above horizon; massive; sticky, plastic; old root channels and concretionary root pipes are common; very strongly acid; clear, smooth boundary.
C3g	46"+	Dark grey (5Y 5/1) clay mottled as above horizon; massive; sticky, plastic; old root channels and concretionary root pipes are common; very strongly acid.

Type Location: The typical profile was described and sampled 400 feet west of Huntley Dam, East Coast Demerara, 3/4-mile south of the railroad.

Range in Characteristics: Colour of the surface soil ranges from black to very dark grey. Reaction of the subsoil and the substratum may be acid, neutral or alkaline, but becomes acid when the soil dries. In some places toxic salts are present in the substratum.

Competing Series and their Differentiae: Weldaad soils are more poorly drained and have darker coloured surface soil than Fairfield soils (147).

Setting: Weldaad soils are in depressions, in areas of level, fine textured marine sediments known as frontland clays. The substratum is soft clay that in many places contains acid sulphates.

Principal Associated Soils: The main bodies lie between areas of Fairfield (147), Rosignol (43), or Onverwagt (41) soils on the side nearer the ocean, and are separated from the river by areas of Brandwagt (32) or of Everton (31a) soils.

Drainage and Permeability: Very poorly drained, probably slowly permeable.

Vegetation and Use: The soils are moderately or poorly suited for most crops. After leaching of salts and addition of lime and complete fertilizer they would be moderately suited for coconuts, sugar cane or ground provisions, and well suited for rice. Land capability subclass IIs.

Distribution and Extent: About 5,000 acres were mapped in areas east of the Mahaica River and south of the railroad in Eastern Demerara. Other areas probably are present between the Mahaica River and Georgetown.

Series Established: Soil Survey of Mahaica-Mahaicony-Abary Area, 1963.

Remarks: The total extent probably is only a few square miles.

Source: Taken from Soil Survey, Mahaica-Mahaicony-Abary Area, preliminary edition released 1964. Arranged in this form by J.G. Steele, November, 1965.

Whim Series, 75

Soils of the Whim series are classified as members of a fine silty or clayey, non-acid family of Aquic Haplorthents; and as Low Humic Gley soils, somewhat poorly drained. The surface soil typically is very dark greyish brown silty clay loam and the subsoil is clay to silty clay loam that is grey mottled with dark brown and reddish brown. They are in narrow strips called reefs, more or less parallel to the coast and slightly higher than the surrounding clay soils.

Typifying Pedon: Representative profile of Whim silty clay loam.

A1	0 - 12"	Very dark greyish brown (10YR 3/2) silty clay loam; fine granular structure; firm, slightly sticky, plastic; common, fine and medium roots; neutral; clear smooth boundary.
B2g	12 - 36"	Grey (5Y 6/1) silty clay loam with many, medium, prominent brownish yellow and yellowish brown mottles; medium sub-angular blocky structure; firm; slightly sticky, slightly plastic; common, fine and medium roots; mildly alkaline; gradual wavy boundary.
C1g	26 - 48"	Grey (5Y 6/1) clay loam with common, medium prominent dark brown and reddish brown mottles; massive structure; slightly plastic; occasional fine roots; lenses of fine sand throughout the horizon; mildly alkaline; gradual wavy boundary.
C2g	48 - 53"	Grey (5Y 6/1) silty clay loam with some fine sand lenses; common, medium, prominent strong brown mottles; massive structure; slightly sticky; plastic; moderately alkaline; gradual wavy boundary.
C3g	53"+	Grey (5Y 6/1) clay, with few medium, prominent strong brown mottles massive structure; sticky and plastic; moderately alkaline.

Type Location: The representative profile was described and sampled about 3 miles from the coast, just east of Port Mourant sugar estate, in Berbice County.

Range in Characteristics: Texture of the surface soil and subsoil ranges from sandy clay loam to silty clay.

Competing Series and their Differentiae: Whim soils contain more sand and are slightly higher than the Whittaker (37), Skeldon (13) or any of the other clay soils of the surrounding swamps. They are more poorly drained and contain more clay than the Ithaca (72) or the Novar (70) soils.

Setting: Whim soils occupy narrow low ridges that are called reefs and lie about parallel to the coast. The reefs are slightly higher than the surrounding clay soils and probably are old beach deposits. The soils contain soluble salts. The substratum is moderately alkaline clay.

Principal Associated Soils: Most areas are surrounded by areas of Tain (9) or of Whittaker (37) soils.

Drainage and Permeability: Natural soil drainage is somewhat poor to poor. Permeability probably is moderate.

Vegetation and Use: Most of the ridges are marked by stands of planted coconut palms. The soils generally have a high content of soluble salts, and leaching of the salt is moderately difficult. After leaching, and with regular applications of fertilizer, the soils are moderately suited for coconuts, sugar cane, ground provisions, pasture, and most other crops, but poorly suited for rice. Capability subclass IIs.

Distribution and Extent: About 990 acres were mapped on the soil survey, mostly east of Port Mourant sugar estate. Other areas occur in the Black Bush Polder vicinity, but the total extent is not large.

Series Established: Soil Survey of the Canje Area, 1963.

Remarks: C.H. Simonson in 1956 identified on the sandy ridges several soils that he believed to be distinct series. Soil surveyors in 1961-64 defined three series of soils on the ridges and that number appears to be enough for practical mapping and interpretation of the soils. Because ridges are of variable composition, considerable range must be allowed in characteristics of each series.

Source: Soil Survey of Canje Area, preliminary release 1964. Compiled in this form by J.G. Steele, November, 1965.

Whittaker Series, 37

Soils of the Whittaker series are classified as members of a clayey, non-acid, soft or moderately firm family of Aquic Haplorthents; also as Low Humic Gley soils, poorly drained. They have a surface soil of dark grey clay, neutral in reaction, a subsoil of grey clay mottled with brownish yellow and strong brown or dark reddish brown, and a substratum of clay or silty clay loam.

Typifying Pedon: Profile of Whittaker clay.

Ap	0 - 15"	Dark grey (10YR 4/1) clay, with common, fine, distinct reddish brown mottles, occurring mainly along root channels; massive structure; firm; sticky and plastic; many fine fibrous roots; neutral; clear, smooth boundary.
B2g	15 - 22"	Grey (5Y 5/1) clay, with common, medium prominent brownish yellow and strong brown mottles; weak subangular blocky structure; firm; sticky and plastic; mildly alkaline, gradual, wavy boundary.
C1g	22 - 46"	Grey (5Y 6/1) clay, with common, medium prominent dark reddish brown and yellowish brown mottles; massive structure; sticky and plastic; few soft very dusky red concretions; mildly alkaline; gradual, wavy boundary.
C2g	46 - 54"	Grey (5Y 5/1 to 6/1) silty clay loam with common, medium, prominent yellowish brown and strong brown mottles; massive structure; sticky and plastic; thin lenses of fine sand occur throughout the horizon; mildly alkaline; gradual wavy boundary.
C3g	54"+	Grey (5Y 5/1) clay; massive structure; sticky and plastic; moderately alkaline.

Type Location: The profile described is about 4 miles south of Gibraltar, on the west side of Albion-Port Mourant Estate.

Range in Characteristics: Colour of the A1 horizon ranges from very dark grey to dark greyish brown. Main colour of the subsoil is grey or greenish grey. The soil below 12 inches ranges from slightly saline to very saline.

Competing Series and their Differentiae: Whittaker soils have a higher salt content than Skeldon (13) or Corentyne (11) soils, and less than Tain (9) soils. They lack the olive mottling that is common in Corentyne soils. Structure in the subsoil is weak subangular, more developed than in the Tain soils.

Setting: Whittaker soils developed in fine-textured marine sediments. In many places they lie between or near sandy ridges of Whim (75) or Ithaca (72) soils.

Principal Associated Soils: Whim (75) and Ithaca (72) soils are on slightly higher ridges. Skeldon (13), Corentyne (11) soils and Tain (9) soils are in similar nearly level areas.

Drainage and Permeability: Poorly drained, probably slowly permeable.

Vegetation and Use: Native vegetation was mostly marsh plants. After the soils have been drained and leached, they are well suited for rice and moderately well suited for sugar cane, ground provisions and pasture, but poorly suited for most other crops. Fertilizer is needed for continued good yields. Capability subclass Is.

Distribution and Extent: Whittaker soils occupy 14,730 acres in the area covered by semi-detailed soil surveys. They are chiefly in the Corentyne section, and it is likely that most of the acreage has been mapped.

Series Established: Canje Area, British Guiana, 1963.

Remarks: None.

Source: Soil Survey of Canje Area, preliminary release, 1964. Arranged in this form by J.G. Steele, January, 1965.

Wichabai Series

In the Wichabai series are soils classified as Oxic Rhodults, members of a deep, clayey family. They are Reddish Brown Lateric soils, well drained. The surface soil and subsoil are dusky red clay; horizons are not distinct.

Typical Profile of Wichabai Clay: Described on the north face of Tup-tupialli Mountain.

0 - 10"	(10YR 3/3) dusky red clay; hard humic layer; strong coarse granular structure; few hard Fe concretions.
10 - 27"	(10YR 3/3) dusky red clay; weak angular blocky medium structure; few hard round small Fe concretions. Roots common.
27 - 54"	(7.5R 2/4) very dusky red clay; soft, weak, coarse angular blocky structure; few roots.
54"+	(7.5R 4/4) weak red cemented ironstone gravel; semi-indurated to indurated ironstone concretions cemented by indurated clay.

Type Location: North face of Tup-tupialli Mountain, near Wichabai in south-western British Guiana.

Range in Characteristics: Not available, 1965.

Competing Series and their Differentiae: Distinctions from the Tiger Creek, and Hosororo series will need to be established after further field studies.

Setting: Wichabai soils are on pediments, over intruded basic rocks. Slope is fairly steep. The bottom of the pediment has a slump appearance which suggests that landslides might occur when the soil is wet.

Principal Associated Soils: Mountain Point soils are on gently sloping pediments underlain by granitic rocks. Sawariwau soils are on undulating uplands that have quartz stones and pebbles, along with small boulders of magnetite on the surface.

Drainage and Permeability: Described as well drained. Probably moderately permeable except where the surface is dry and hard.

Vegetation and Use: Savannah grasses and shrubs growing in "orchard" formation. The vegetation is more luxuriant than on any other area in the savannahs covered in the soil survey (Loxton, 1958). The soils are productive, and with care, and especially with soil conservation measures, can be used for crops.

Distribution and Extent: Mapped on 12 square miles in the Rupununi Savannahs. Further extent, if any, still to be investigated (1965). The main body mapped is located just west of Wichabai.

Series Established: Soil Survey of the Rupununi Savannahs, published March, 1958.

Remarks: The classification is tentative, subject to correction. If the series is to be retained, differentiae from competing series need to be established and recorded.

Sources: Soil and Land Use Surveys, No. 2, British Guiana. Regional Research Centre at I.C.T.A., Trinidad, March, 1958. Assembled in this form by J.G. Steele, October, 1965.

Wikki Series, 712

Soils of the Wikki series are classified as members of a sandy, siliceous family of Psammentic Umbriorthox; and as Rubrozems, well drained. They have a thick, very dark grey to black surface soil of loamy sand over light yellowish brown to pale brown subsoil of friable sandy loam to silty clay loam.

Typifying Pedon: A description of a typical profile was not obtained on the Ebini-Ituni-Kwakwani soil survey, and none is available in 1965.

Type Location: Ebini-Ituni-Kwakwani area.

Range in Characteristics: Similar to that of Kasarama loamy sand except for the thick, dark grey or black surface horizon.

Competing Series and their Differentiae: The surface soil is thicker and darker than that of Kasarama loamy sand.

Setting: The soils are on gently sloping and undulating relief, in areas of the sandy sediments of the Berbice formation.

Principal Associated Soils: Kasarama soils (810) are in places where the thick dark surface layer has not been formed. Other associated soils are the same as those listed for the Kasarama series.

Drainage and Permeability: Well drained, rapidly permeable.

Vegetation and Use: Native vegetation is mostly forest but partly savannah. The soils are extremely acid and low in natural fertility. Suitability for crops and needs for treatment are similar to those of Kasarama soils. Capability subclass IIf.

Distribution and Extent: Wikki soils occupy only 980 acres in the Ebini-Ituni-Kwakwani area.

Series Established: Soil Survey, Ebini-Ituni-Kwakwani Area, 1963.

Remarks: Wikki soils resemble Kasarama soils except for the thick, dark coloured surface soils. Their suitability for crops and their need for fertilizers and soil amendments are the same as those of Kasarama soils. It is recommended that on future soil surveys the name Wikki can be dropped, and these soils can be classified as a dark surface soil phase of Kasarama soils.

Source: Soil Survey of Ebini-Ituni-Kwakwani Area, released in preliminary form, 1964. Compiled in this form by J.G. Steele, January, 1966.

Wiruni Series, 742

Soils of the Wiruni series are classified as members of a fine loamy family of Typic Umbraquults; and as Humic Gley soils, very poorly drained. They consist typically of a thick, very dark grey or black loamy sand or sandy loam surface layer, over light grey to yellowish brown sandy clay loam subsoil.

Typifying Pedon: Representative profile of Wiruni loamy sand.

A11	0 - 12"	Black (N2/0) loamy sand; weak fine granular structure; loose, very friable; non sticky, non plastic; common medium to fine roots; extremely acid; gradual smooth boundary.
B1	12 - 22"	Very dark grey (10YR 3/1) sandy loam; weak medium to fine angular blocky structure; non sticky, non plastic; friable; common fine roots; extremely acid; clear wavy boundary.
B2	22 - 30"	Light grey (10YR 7/2) sandy loam; common medium, prominent brownish yellow and soft concretionary red mottles; massive structure; friable, slightly sticky, slightly plastic; extremely acid.

Type Location: The representative profile was described and sampled about 4-3/4 miles north-northeast of Ebini Livestock Station in north-eastern British Guiana.

Range in Characteristics: Texture of the surface soil ranges from loamy sand to sandy loam, and colour from very dark grey to black. Texture of the subsoil is sandy loam or sandy clay loam, and its colour ranges from light grey to light yellowish brown. In some places the subsoil is mottled with red or yellowish brown, or contains soft concretions.

Competing Series and their Differentiae: Wiruni soils are similar in texture to Mibirikuru (740) soils, but have a thicker dark coloured surface layer. The Wiruni and the Mibirikuru soils are less sandy than the Henrietta (730) and the Siparuta (732) soils, and more sandy than the Arima (750) and the Aroaima (752) soils. The subsoil is more grey, the surface soil is darker, and natural drainage is poorer than that of the Kasarama soils (810).

Setting: Wiruni soils are along small streams and in depressions or potholes, in medium textured sediments of the Berbice formation. In many places the micro-relief is very uneven,with many steep-sided humps about a foot wide and a foot high. Some of the depressions lack natural outlets.

Principal Associated Soils: Kasarama soils (810) are on the better drained uplands. Mixed alluvial land and muck or peat are on some of the adjacent lowlands. Mibirikuru soils (740) are in similar locations where soil texture is about the same, but they have a thinner dark coloured surface layer.

Drainage and Permeability: Wiruni soils are very poorly drained, and probably slowly or very slowly permeable. Artificial drainage of many areas would be difficult because of the lack of outlets.

Vegetation and Use: Native vegetation is forest or savannah. The soils are extremely acid, low in plant nutrients, and flooded during part of each year. Some annual crops might be grown during dry seasons if lime and fertilizer are applied. Drainage would be required for long-season crops. Pasture might be obtained during dry seasons, but without fertilizers the yields would be low. Capability subclass IIIw.

Distribution and Extent: Wiruni soils occupy about 2,400 acres in the Ebini-Ituni-Kwakwani soil survey area. A small but significant acreage probably occurs throughout the gently sloping sandy plains.

Series Established: Soil Survey, Ebini-Ituni-Kwakwani Area, 1963.

Remarks: Since the degree of base saturation is low, possibly the soils should be classified as Oxic Umbraquults.

Source: Soil Survey, Ebini-Ituni-Kwakwani Area, preliminary report, 1964. Compiled in this form by J.G. Steele, January, 1966.

Yarakita Series, 352

The Yarakita series was named and mapped in the soil survey of the Wauna Area by Harold N. Ramdin and Clyde C. Applewhite, 1964. The soils were described as shallower than soils of the Wauna series but otherwise similar. Studies in 1965-66 revealed no consistent differences in depth, although possibly more fragments of granite are present in the soils first designated as Yarakita. The Yarakita series therefore has been combined with the Wauna series.

Slope phases of the Wauna soils should be mapped on future soil surveys of medium intensity. Shallow or moderately deep phases should also be recognized if they are found to be significant.

Yesi Series, 158

In the Yesi series are soils classified as Plinthic Normudults, members of a fine silty family (Red-Yellow-Podzolic soils, well drained). They normally have a dark brown surface soil, thick, yellowish brown sub-surface soil, a red subsoil mottled with yellowish brown and yellowish red, and a mottled red and light yellowish brown substratum.

Typical Profile of Yesi Silt Loam:

O1	1 - 0"	Leaves and other vegetative residue.
A1	0 - 8"	Brown to greyish brown (10YR 5/3 - 5/2) silt loam; weak fine granular structure; friable; non sticky and slightly plastic; many fine and medium, occasional large roots; few worm holes; extremely acid; gradual smooth boundary.
A2	8 - 12"	Brown to pale brown (10YR 5/3 - 6/3) silt loam with few, fine, faint yellowish brown and strong brown mottles; medium to fine granular structure; friable; non sticky and slightly plastic; many fine and medium roots; many worm holes and root channels and some dead roots; extremely acid; gradual wavy boundary.
B1	12 - 16"	Brown to dark brown (10YR 5/3 - 4/3) silt loam with common, fine, distinct yellowish red mottles; soil breaks into irregular peds; friable; slightly plastic; many fine roots; root holes and worm channels; extremely acid; clear wavy boundary.
B2	16 - 23"	Yellowish red (5YR 5/8) silty clay loam with few fine reddish yellow mottles; soil breaks into irregular peds; some penetration of grey and white from top layer; thin clay flows; friable; many medium and fine roots; many worm channels; some worm casts; extremely acid; gradual wavy boundary.
B3	23 - 41"	Mottled brownish yellow, light grey and reddish yellow silty clay loam; few dark red soft concretions; medium to coarse subangular blocky structure; friable; many old roots and worm holes; extremely acid; gradual, wavy boundary.
C	41 - 51"	Grey (5Y 6/1) silt loam with many large, prominent red and yellow mottles, massive structure; friable; slightly plastic; few fine roots and root channels; evidence of clay flows along vertical peds; extremely acid.

Type Location: About 3/4 mile north of Torani Canal, 4 miles west of Canje River, Berbice County.

Range in Characteristics: The principal type is silt loam. Colour of the A horizon ranges from dark brown to greyish brown. Depth to the first mottled layer is in most places 20 to 36 inches. A few hard dark red concretions are present in some places in the lower B2 horizon, and are likely to be common in the C horizon. The pale brown mottles of the C horizon grade into white mottles with increasing depth. Texture of the B horizon ranges from silty clay to silty clay loam. Colours are given for the moist soil; values are one or two units higher if the soil is dry.

Competing Series and their Differentiae: Yesi soils are better drained than Potoco soils (157), as indicated by darker surface soil and more mottled and gleyed subsurface soil and subsoil. They are slightly better drained than Dageraad soils, and lack the darker red, soft concretionary mottles that are present in the C horizon of those soils. They contain more clay in the B horizon and are better drained than Moleson soils (8). They lack the dense silty layer (fragipan) that is present in Kamani soils.

Setting: Yesi soils developed under forest cover in old, leached, silty alluvial sediments of the Coropina formation. Dissection has produced undulating topography, with slopes ranging from 1 to 5 percent, but mostly from 1 to 3 percent.

Principal Associated Soils: More poorly drained soils in similar silty materials are members of the Potoco (150), Torani (153), Cola (152) and Putkin (156) soils. Other associated soils are members of the Vigilante (54) and Huntley (253) series. Also in the same localities but generally under savannah vegetation are Kamani (53), Helvetia (52), Nassau (57) and Dageraad (58) soils.

Drainage and Permeability: Well drained or moderately well drained. Moderate surface runoff and moderate internal drainage. Moderate permeability.

Vegetation and Use: Tropical rain forest including kokerite palm (Maximiliana regia) wild plantain (Heliconia psittacorum) kunta (Licania kunthiana) Kakaralli (Eschweilers sp.) mucru (Ischnosiphon arouma) silk cotton (Ceiba pentandra) and bloodwood (Vismia angusta) along with several kinds of low-growing bushes. A large part is in forest. Cleared areas are used for bananas, plantains, ground provisions, coconuts and pasture. Shifting cultivation is common. Capability subclass IIf.

Distribution and Extent: In the Coastal Plain of British Guiana, near the boundary of the more rolling sandy soils, mostly between the Demerara River and the Corentyne River.

Series Established: Canje Area, British Guiana, 1963.

Remarks: Experience is lacking on performance of crops in regular cultivation with use of fertilizers and lime.

Sources: Described by Glenn H. Robinson, 1964. Arranged in this form by J.G. Steele, 1965.

Soil names in published reports but omitted from the foregoing list

The following soil names appear in soil survey reports published by the Regional Research Centre in 1958 or 1959, but for the reasons indicated were omitted from this compilation in 1966 of approved descriptions of soil series. Five of the names were applied to soils in the Kamarang and Kukui Valleys, where soils were studied but no soil mapping was done. The range of characteristics within each of those five series was not defined. When further soil mapping is done in these areas, it is likely that some of the soils to which these names were given can be correlated with established series.

Alema: Applied to a soil containing lateritic gravel, on low undulating gabbro hills in the Kukui Valley. It appears that the soils might be correlated with the Hosororo series.

Amakokapai: An alluvial soil on a low river terrace; a uniform clay loam to clay with well developed fine angular blocky structure. Future study will be needed before the series is established.

Bullet Tree Island: This name was given to imperfectly drained soils associated with Tiwiwid and Kasarama soils in the vicinity of the Ebini Livestock Station. The soils were classified in greater detail in the Ebini-Ituni-Kwakwani soil survey of 1963, and the name Bullet Tree Island can be dropped.

Jawajapai: This name was given, in the Kamarang of Kukui Valley, to free to imperfectly drained, very acid soils on low river terraces and flood plains where a mixing of alluvium derived from gabbro and sandstone rocks has taken place. If the series is needed when soil mapping is done, its limits and range of characteristics will need to be defined.

Kangaruma: The Kangaruma series was mentioned in the soil survey report of the Mahdia Area (1959) but the mapping unit shown is one of undifferentiated alluvial soils. Classification of the alluvial soils will need to be re-examined if further soil mapping is done.

Kimbia: This name was used for soils associated with Tiwiwid soils (700), but containing slightly more clay, in the vicinity of the Ebini Livestock Station. It was not recognized in the more extensive soil survey of the Ebini-Ituni-Kwakwani Area in 1963. The name can be dropped.

Pakaraima: The Pakaraima complex was described as an association of steep soils on lower slopes of the Good Hope-Annai Mountains just north of the Rupununi Savannahs (Soils and Land Use Surveys No. 6, 1959). The component soil series were left un-named.

Paruima: This name was applied to soils on pediment slopes beneath gabbro outcrops at Paruima Mission in the Kamarang Valley. The name would be appropriate if a Reddish Brown Lateritic soil of high base status is found to occupy mappable areas. Field tests in 1966, however, showed these soils near the Paruima Mission to be extremely acid. The Wichabai soils in the south-west were also described as soils of fairly high base status.

Pipilipai: This name was applied to alluvial soils derived from sandstone in the Kamarang and Kukui Valleys, but no map was made. The soils probably are extensive enough to deserve series status when soil mapping is done. A description of the series will be needed.

Serebekabra: This name was applied, in the Soil Survey of the Bartica Triangle, to soils grading between Tiwiwid (700) and one or another of the brown sandy soils, probably Kasarama (810). Possibly the transitional soils can be classified as phases in future soil mapping. If the Serebekabra series is re-established, its limits will need to be determined.

I ALPHABETICAL LIST OF SOIL SERIES

Symbols are given for the soil series established after 1961. An asterisk indicates a name that has been changed or dropped.

Ambrose
Anira 20
Arakaka 360
Arima 750
Aroaima 752
Baiabo 220
*Bartica (changed to Torani)
Bath 34a
Benoni
Black Bush 3
Brandwagt 32a
Brickery 36
Burru
Burton 45
Cachoeira
Canje 31
Charity 14
Cola 152
Corentyne 11
Dageraad 58
Dead Man Swamp
De Velde 1
Durban
Kuma
Kwainatta
Lama 60
Lethem
Lichfield
Long Man Swamp
Macouba 30
*Mahdia (See Durban)
Makushi
Manarabisi 211
Mara 21
Marabunta Creek
Marinero 101
Mibirikuru 740
*Minnehaha (See Wauna)
Mixed Alluvial Land
Moleson 8
Mountain Point
Nassau 57
Novar 70
Onverwagt 41
Plegt Anker 5
Potoco 157
*Prosperity Creek (See Tiger Creek)
Putkin 156
Rosignol 43
Rupununi
Ebini 820
Emprensa
Everton 31a
Fairfield 147
*Halchica 720 (See Ebini)
Haswell 25
Helvetia 52
Henrietta 730
Hosororo 340
Huntley 253
Ikuribisi
Inki 100
Ireng
Ithaca 72
Ituni 701
Jacaré
Kamani 53
Kangaruma
Kaput
Karanambo
*Kariakuri 221
Kasarama 810
Kerkenama 32
St. Ignatius
Sawariwau
Serebekabra
Siparuta 732
Skeldon
*Stewartville (See Corentyne)
Tabela 800
Tain 9
*Takama 710 (See Kasarama)
Tarakuli 702
Tiger Creek
*Tin Creek (See Hosororo)
Tirke
Tiwiwid 700
Torani 153
Tuschen 39
Vigilante 54
Vryberg 34
Waruma
Wauna 350
Weldaad 44
Whim 75
Whittaker 37
Wichabai
Wikki 712
Wiruni 742
*Yarakita 352 (See Wauna)
Yesi 158

NUMERICAL LIST OF SOIL MAP SYMBOLS, 1961 THROUGH JUNE 1966

An asterisk indicates that the name has been changed or dropped.

1	De Velde
3	Black Bush
5	Plegt Anker
8	Moleson
9	Tain
11	Corentyne
13	Skeldon
14	Charity*
20	Anira
21	Mara
22	Mara, peaty (See 21)
25	Haswell
30	Macouba
31	Canje
31a	Everton
32	Kerkenama
32a	Brandwagt
34	Vryberg
34a	Bath
36	Brickery
39	Tuschen
41	Onverwagt
42	Lichfield
43	Rosignol
44	Weldaad
45	Buxton
52	Helvetia
53	Kamani
54	Vigilante
57	Nassau
58	Dageraad
60	Lama
70	Novar
72	Ithaca
75	Whim
100	Inki
101	Marinero
147	Fairfield
152	Cola
153	Torani* (changed from Bartica)
156	Putkin
157	Potoco
158	Yesi
211	Manarabisi
220	Baiabo
221	Kariakuri
253	Huntley
340	Hosororo
350	Wauna
352	Yarakita*
360	Arakaka
365	Alluvial soils undifferentiated
653	See 53
658	See 58
700	Tiwiwid
701	Ituni
702	Tarakuli
710	Takama*
712	Wikki
720	Halchica*
730	Henrietta
732	Siparuta
740	Mibirikuru
742	Wiruni
750	Arima
752	Aroaima
800	Tabela
810	Kasarama
820	Ebini