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MANUAL ON MAP STANDARDS & SYMBOLS FOR SOIL & WATER GIS

BUREAU OF SOILS AND WATER MANAGEMENT
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BUREAU OF SOILS AND WATER MANAGEMENT
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FOR SOIL AND WATER GIS
Integrated Soil Resources Information Service Staff
Bureau of Soils and Water Management
Elliptical Road, Diliman, Quezon City

December 2009

Preface

It is with great pride that we come up with this cartographic symbolism manual which in effect sums up the state of digital cartography in the Bureau of Soils and Water Management (BSWM). This addresses Geographic Information System (GIS) issues pertaining to the standardization of map composition and defining the institutional style. The original manuscript was based on the standardization workshop between the Integrated Soil Resources Information Service (ISRIS) and the Cartographic Operations Division (COD) in 2008. The workshop output was updated and the subjects expanded to include topics not originally covered such as Soil Survey map symbols and standards.

The release of this manual is hinged on basic assumptions and policy directions, basically, the strengthening of BSWM's role in soil geography, agricultural land resources assessment, and geospatial data/knowledge management through the merging of the ISRIS and COD into Geomatics and Soil Information Technology Division under the BSWM Rationalization Plan. The leap to digital cartography may not be that easy considering the limitations in manpower and equipment capability; nevertheless, even an inch by inch forward movement can contribute significantly to development. Who knows, the merged group can become the National Soil and Water Cartography and Geospatial Development Center in the future?

We are starting preliminary activities for our digital cartographic operations to come up with outputs as support to the programs and projects being pursued by Soil Survey, Agricultural Land Management Evaluation, Soil Conservation and Management, and Water Resources Management Divisions. For example, we anticipate the release of second edition of Strategic Agriculture and Fisheries Development Zones (SAFDZ) based on most recent satellite imageries within the next two years. A possible offshoot of this is an updated agricultural land use map. There are many other derivative maps that we could come up with. Thus, we have to rush the completion of this manual as the first set of ISRIS/Carto-developed maps are expected to begin production.

As you could see, this manual is an important first step for the innovative use of GIS and other technology tools to support and expand the delivery of cartographic services to our clientele. The sale of maps is second to the laboratory analyses as major services provided by BSWM through its Client Center. We hope to make this manual the basic document by every map compositor in the soil and water resources management field.

Director's Message

The developments in soil survey and classification, the core of this symbology manual for Geographic Information System (GIS) mapping, is moving very fast such that even before this manual leaves for the press, our basis (the tenth or the 2006 edition of the Keys to Soil Taxonomy) is already superseded by the release of the Eleventh (2010) Edition. Although we were able to obtain from the internet advance copy of the eleventh edition, we did not anymore change the manuscript before going to the press because much of the changes concern taxonomic subgroups not found in the Philippines.

Nevertheless, a major taxa that local soil surveyors should be aware of, is the addition of 6 great groups in Entisols for subaqueous soils: Fluviwassents, Frasiwassents, Haplowassents, Hydrowassents, Psammowassents, and Sulfiwassents. Similarly, additional suborder Wassists for subaqueous soils in Histosols have been added: Frassiwassists, Haplowassists, and Sulfiwassists. In Inceptisols, a new great group Humudepts with 17 new subgroups as well as Humustepts with 7 new subgroups have been added. We came up with a supplemental chapter to cover up the legend additions in Soil Taxonomic mapping instead of revising the final manuscript.

Originally, this manual was prepared as an offshoot of ISRIS-Cartography consultation workshop held in the Makiling Highlands, Los Banos, Laguna in 2008. But because of the dynamics of Soil Survey and Classification, map legends not originally included in our legend list based on SIS (circa 1995) and ARIS (circa 2005 but did not revise the SIS component) have to be further revised because of the 2003 and 2006 editions of the Keys to Soil Taxonomy. Thus, the delay in the publication of this technical bulletin from June to December, 2009.

I personally think that such rapid advances in soil survey and classification is very good for Soil Survey Division (SSD), especially that we are yet to implement our Rationalization Plan. How can the national government phase out such a very dynamic division, whose international knowledge base moves forward very fast to the point that this manual has become in a way somewhat obsolete even before it is published? There are

very few national organizations except maybe those relating to information technology that could come up with a manual that becomes obsolete even as it goes to the press. The challenge is not only in coping up with these fast international developments in soil survey and classification, but we also need to recruit younger blood of soil surveyors with the retirement of our experienced ones. This is not only true for the Philippines but even for the developed and industrialized nations where much of these scientific developments come from.

By the way, you would notice that although we are now using ArcGIS, the manual is still ArcView. Not only we still use our old GIS softwares because they are licensed and we do not dispose of them; but more so, because it provides good foundation to new learners. Once GIS map compositors are familiar with the various concepts in ArcView, it would be easy to navigate in ArcGIS.

Once more, let me congratulate ISRIS and COD for making efforts to move from analog to digital cartography and also the Soil Survey Division (SSD) for consolidating their legend list. The SSD "trade secret" is finally out! All these past decades, there is no published list by the BSWM of all the soil series in the Philippines. I thank Cartographic Services Division and ALMED also for the cooperation extended as we lay down the groundworks to convert to digital data much of our analog map outputs.

SILVINO O. TEJADA
Director

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Integrated Soil Resources Information Service. Bureau of Soils and Water Management (3): 1—6, 2009

Conceptual Framework For Spatial Data Management

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Under the Rationalization Plan of the Bureau of Soils and Water Management (BSWM), the Integrated Soil Resources Information Service (ISRIS) and the Cartographic Operations Division (COD) will be merged into *Soil Information Technology and Geomatics Division*. The development of digital cartography will bring about a total change in many ways that BSWM, as a mapping arm of the Department of Agriculture, operates. Much of the manual mapping activities will be rendered obsolete. Even interpretation of aerial photographs will have to be digital. This will require adjustments in skills and operations.

BSWM uses ArcGIS 9 for its Geographic Information System (GIS) and ERDAS Imagine for the processing of satellite imageries. Mobile GIS using iPaq is also under development, and field data will have to be inputted digitally as actual field validation is on-going. As ESRI GIS products are the major softwares for the generation of maps, the conceptual framework for the development of digital cartography in BSWM is based on ESRI's cartographic capabilities and trends. Figure 1 shows the ESRI framework for cartographic data management.

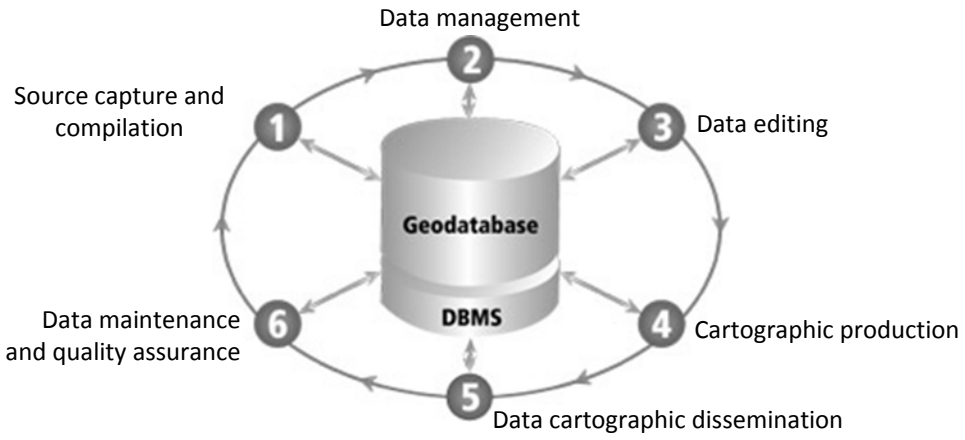

Figure 1. Spatial data management for digital cartography. Source: ESRI

The **Geodatabase** at the center of the figure refers to the common geodatabase currently maintained at ISRIS which centralizes spatial data generated from all the technical divisions of BSWM. Under a networking of digital cartography, the technical divisions including field operations shall be able to access the spatial inputs. Under a merger concept of ISRIS and Cartographic Operations Division, all spatial data outputs of BSWM shall henceforth be digital. There shall be efforts to translate all old analog maps to digital data later on. The Geodatabase is the central repository for spatial data in BSWM.

The data stored can be versioned to allow multiple users carry out simultaneous update with optimistic long transactions to prevent unnecessary locking or data copies. This allows map finishing to meet deadlines while continuing with on-going database update. In ArcGIS 9, the geodatabase has a range of performance and scalability improvements and enables integration of raster data.

1. Source capture and compilation

Capture of the field data provided by the technical divisions (by digitization or scanning) and the source data are compiled in multiple formats such as vector data, raster data, data from imageries, grid data, terrain models.

ISRIS has the capability to share, import, integrate, and synchronize digital spatial datasets into operational databases to meet the requirements of the different technical divisions. By merging with Cartographic Operations Division, the new division will have a comprehensive database based on standardized, multi-scale data model.

An emerging new field is Mobile GIS. Mobile GIS is the expansion of GIS technology from office to the field and enables field-based staff to capture, update, manipulate, analyze, and display geographic information. Mobile GIS integrates mobile devices, global positioning system (GPS), and wireless communication for internet GIS access.

Traditionally, field surveyors use a reproduced copy of a topo map or a base map called *working map* where they put annotations and delineations of field observations. Upon return to the office, the delineations are digitized and the observation sites geoprocessed; soil morphological, chemical, physical, and other site data are also keyed in. Recent developments would enable field staff to take with them digital maps on compact mobile computers providing field access to BSWM's geodatabase. This enables real-time editing to the database and application, speeding up analysis, display, and decision making by using up-to-date and more accurate spatial data. For personal digital assistance (PDAs), BSWM has hand-held iPaq. USDA for example has developed field data recorder, *PedonCE* for describing soils to collect detailed soil descriptions electronically in the field. The data can be directly exported to the Soil Information System.

Soil surveyors can download the installation package of PedonCE from http://nasis.usda.gov/downloads/ or communications can be made with Alan Price, NRCS, Colorado (E-mail: alan.price@co.usda.gov).

ArcPad with GPS will be needed for realtime location.

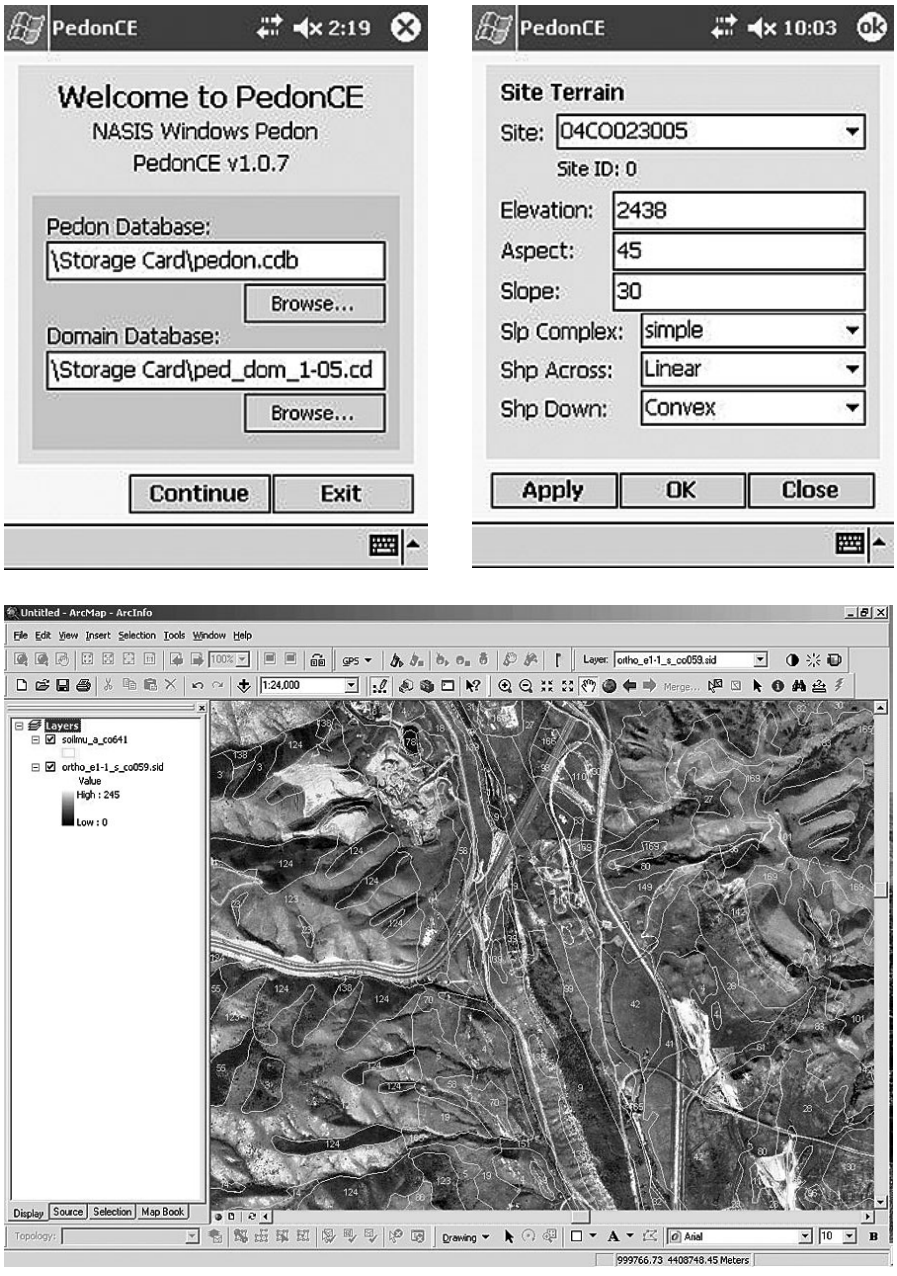

Figure 2. PedonCE (above) developed with ESRI's Professional Service Division to do away with handwritten detailed soil descriptions during field validation; data to be automatically inputted to soil mapping unit (map below) using hand held iPaqs. The map can be downloaded from BSWM geodatabase.

Figure 3. A sample HP iPaq (Mobile GIS) that can be used during field validation. There are many other models and brands available in the market today.

2. Data Management

With requirements to manage large volumes of data and maintain a multitude of cartographic specifications, a database-driven production system is needed. ISRIS through its GIS Section provides the data management for digital files. The GIS Section collects and shares high-resolution, strategic geographic data layers from different BSWM programs and projects. This provides a more consistent approach to information management and enables the integration of individual computing nodes into a "system of systems".

Data development and maintenance is the most costly and labor intensive part of GIS. Not every agency is blessed with existing GIS data for their project. As a pioneer in GIS since its infancy way back in the 1990s, BSWM need not focus on new data from field research but build on existing database. Data creation can be tedious and slow process, and certainly expensive.

Beyond data creation, data management is an important key. Often, data sets that originate from specific BSWM projects need some work to be usable for another project. Updating an existing data set is better than creating one from scratch. Still, sometimes the process takes more work than starting fresh.

The most important thing in data management is to be able to retrieve the spatial data as we need them.

3. Data editing

The power of GIS is in the data analysis. Spatial overlay is most common technique to come up with a derived map given the spatial factors or parameters.

Data-base driven map, chart, and data production requires massaging and editing the original source data into a database that can be leveraged to produce

various data and cartographic products. Fusing of multiple data sources requires georectification and data generalization to strict specifications. Editing includes changes in geometry, related attributes, and validation of edits against a specification knowledge base. In-process quality control is required during data entry for quality compliance with specifications.

4. Cartographic Production

This is what this Manual is all about.

Symbolization and text placement are at the heart of cartography. There are sophisticated cartographic rule base that are defined by the different technical divisions that avail of geomatic services. This step provides a rich set of functions for defining and applying symbolic styles to the point, line, or area contained in a map. Symbolization can also be applied to cartographic elements such as graphics and marginalia. Data-base driven cartography eliminates the need for multiple databases and maintains the geographic integrity of the data. GIS features and attributes can generate many cartographic representations enabling symbolization for various data themes and map scales.

GIS practically enables anyone who knows how to run a computer create maps. However, it does not necessarily be a good map. Cartographers invest many years to perfect their techniques; and such experiences over time enable them to develop a style that communicates concepts effectively and create maps that are interesting to look at.

Secondly, many countries have published spatial data exchange standard. In the transfer of spatial information, the most common lost is the symbolic presentation of spatial data, specially as we move from one GIS platform to another.

Thirdly, the advent of digital cartography will bring about many changes on the map symbols being used by BSWM. Obviously, some of the current symbols could not be converted digitally. It is the objective of this paper to consolidate them into an initial Map Symbol Library or manual.

5. Data and cartographic dissemination

Map outputs are printed sold to the general public. Project-based maps are turned over to the project proponents.

Under the Republic Act 9485, also known as the Anti Red Tape Act of 2007, BSWM is putting up a Client Shop where both analog and digital maps are sold. There is a catalog that list all the maps available for sale.

BSWM maps are available either as printed copy or as digital (PDF) stored in compact discs. Shape files are also available but at higher price.

6. Data maintenance and quality assurance

This is inherent in any mapping production process. Maintaining the data makes the production and dissemination of information easier and more efficient. Maintaining the quality of data throughout the production process is paramount to avoid degrading existing information as new features are added, edited, or deleted. The philosophy of in-process quality control is regimented throughout the production and maintenance workflows. Quality assurance is necessary as it is the final verification and recording of data integrity before a data or map product is published or disseminated.

Standard Mapping Procedures

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Standard operating procedures are necessary for clarifying the Geographic Information System (GIS) needs and functions of the Bureau of Soils and Water Management (BSWM) in support of soils, water, and land resources management. This is also to provide consistency in information delivery, especially of GIS products and related services.

This mapping manual is prepared on the assumption that BSWM will implement digital cartography. For smooth transition, existing analog mapping procedures are contrasted with revised procedures for digital mapping.

ANALOG CARTOGRAPHY	DIGITAL CARTOGRAPHY
Step 1. Preparation of base map for field survey	
A. AMS topographical map series, scale 1:50,000 and 1:250,000 ♦ Procurement of topomaps ♦ Reduction or enlargements to desired publication the scale of the map ♦ Final drafting on stable base material ♦ Preparation of sketch map for various soil mapping activities	A. Where digital spatial data is not available ♦ Procure topomaps/other maps. ♦ Convert analog maps to digital either by manually digitizing (ArcInfo) or by scanning (300-400 dpi) and automatic vectorization. ♦ Edit/clean maps ♦ Save in either ArcInfo export format (e00) or Arcview shape file format.
B. Aerial Photographs ♦ Producrement of photographs of the desired area ♦ Preparation of photo index map showing location of photo centers for each corresponding photographs, flight numbers, and photo numbers ♦ As maybe necessary, preparation of photo-mosaic, controlled, semi-controlled as photo-base.	B. Where digital data is available ♦ Retrieve satellite imagery, aerial photographs, and/or base map to personal digital assistance (e.g. hand-held iPaq) for use in the field. *Note: Field surveyors should learn how to put annotations and edit digital data stored in Mobile GIS during actual field validation activities.*

ANALOG CARTOGRAPHY	DIGITAL CARTOGRAPHY
Step 2. Preparation of Initial Map/Map Manuscript/Working Map for use by field surveyors	
All maps are to be prepared in the field by surveyors conducting surveys using conventional mapping symbols.	Field surveyors bring hand-held personal digital assistance (e.g. iPaq) loaded with necessary spatial data (satellite images, aerial photos, soils, land use, etc.) during field work.
Step 3. Initial editing	
A. All field plans, maps, and data must be edited, reviewed and complied by the Survey Team exercising technical supervision prior to map production B. Photo-interpretation verified through field survey operations must likewise be edited, reviewed, and compiled by the Survey Team prior to production of the final map. C. Computation of areas for each corresponding mapping units must be finalized at this stage.	Using PDAs or Mobile GIS instrument during field activities, all entries (new data, corrections, delineations, updates, etc.) will have to be entered digitally.
Step 4. Final map preparation	
A. 1. Computation of geographic coordinates on mapped areas. 2. Composition of final map layout including legend, box, editorial notes, and border information. 3. Transfer all mapping details from field photos to the final base map by enlargement or reduction using mechanical or photo mechanical process. B. 1. Computation of geographic coordinates on mosaic area 2. Preparation of sheet layout on mosaic original. 3. Preparation of half-tone negatives for each map sheet by camera process.	A. Transfer all field gathered data to BSWM Geodata Base. B. Use ArcView to retrieve spatial data, analyze, and compose. C. Use A3 or A4 for printing of initial draft and further corrections.

ANALOG CARTOGRAPHY	DIGITAL CARTOGRAPHY
4. Preparation of stick-up type positives. 5. Preparation of stick-up type negatives 6. Perfection and register of half-tone negative and type negative. 7. Preparation of positive reproducible from mosaic original.	

Step 5. Final editing

All map sheets must be edited for cartographic aspects and mapping information by designated technical and map specialists prior to printing and mass production .

Step 6. Printing or Reproduction

A. For one color final map product, ozalid or diazo print, dry or wet process will be the end product. B. For color separation, printing will be done by an agency using modern cartographic techniques for color map reproduction. C. For limited production, hand colored copies of ozalid or diazo prints will satisfy the needs for a colored map. D. At least 6 copies will be sent to the library as reference materials.	A. All map outputs will be saved as PDF and as JPEG images. B. Digital maps for sale/distribution will be mass reproduced through compact discs. C. If there is a need for hundreds of copies, a camera-ready map will be prepared for printing and mass production to be contracted out to a printing agency. For limited map production, the plotter can take care of this need.

SEQUENCE OF MAPPING OPERATION

Analog Cartography	*Digital Cartography*
1. Base map preparation 2. Data generation/Field survey 3. Field map manuscript 4. Map design 5. Final map manuscript (reproducible) 6. Printing	1. Digitize/scan/retrieve base map elements (satellite images, boundaries, etc.) ; overlay 2. Export base map to Mobile GIS (iPaq) 2. Input directly the annotations/observations at hand-held iPaq during field validations 3. Transfer field data to BSWM Geodata base
Color Separation Process	*Map Composition*
7. Scribe negatives 8. Type overlay 9. Printing proof 10. Printing plates 11. Printing	5. Retrieve spatial data using ArcView 6. Do map composition using ArcView 7. Save map outputs as PDF and JPEG 8. Reproduce in compact discs and/or contract printing agency to mass reproduce (print camera-ready map)

Map Design Using ArcView:

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As project staff are expected to dispense with paper-based base map to input their field observations during field validation but use hand-held personal digital assistant (PDA) such as iPaq pre-loaded with satellite imagery, base map elements like political boundaries and locations of institutional markers, and initial delineations (soils, land use, land management units, etc.) — project staff are likewise expected to learn ArcView to transfer their observations to the BSWM Geodatabase, and retrieve them for map composition.

Map composition can also be delegated to project cartographers and draftsmen who are expected to be familiar with the basics of ArcView. It is not the purpose of this manual to republish the step-by-step procedures to compose a map in ArcView. Please refer to ArcView manual or ESRI website publications. What we want to do is to standardize the symbols used for soil and land resources mapping using GIS.

1.0 Fundamentals of map design

1.1 Begin by defining the map purpose and audience

As in other fields of endeavour, preparing a map has a purpose and a target audience. Who will use the map? What do you want the user to remember most? BSWM clients are mostly other government agencies who need baseline soil resources data for policy and rural development planning. There are also academicians, consultants, environmentalists, architects and civil engineers, farmers, entrepreneurs, researchers, and natural resource managers.

1.2 Make your map tell a story

Design a map that takes your reader on a journey. You don't have to unfold your messages all at the same time, but do it in layers. As viewers look more closely at the map, additional information beyond the primary message will emerge. This can be done by using different font sizes in labelling.

1.3 Keep your map simple

A map should have a clear primary message. Do not clutter the map with information that are not essential. Scale bar and north arrow should not draw attention from the main body. The map title should not be hiding in small font.

1.4 Direct the viewers' eyes

Various map elements should be integrated and draw the viewers' interest to map messages in their order of importance. Use strongest colors for most important features. Avoid using dark royal blue for lakes and other background water features so that they do not dominate the viewers' perception.

1.5 Design for viewing distance

Every map has an optimal viewing distance. Page size maps (A4, letter size) are normally prepared for a comfortable reading by an individual. For public viewing in an occasion or special event, a poster-size map such as A1 or A0 could be seen at 10 feet or more.

2.0 Map Layout in ArcView

This procedure assumes that the map layout artist is familiar with basic concepts of ArcView. We only highlight major steps to layouting maps in ArcView. Please refer to ArcView manual for details on how to create maps, add tabular data, use of the Legend Editor to symbolize the data, choosing map projections, creating and editing spatial data, working with images and CAD drawings.

2.1 Make the Project window active. From the View menu, choose Layout. In the Template Manager, choose either a landscape or a portrait.

2.2 Set-up the layout page. At the Layout menu, choose Page Setup. The dialog box allows you to specify margins. Take note that as you change to a larger paper size, the whole layout will appear larger. You may need to readjust margins. By default, grids appear and map components would automatically snap for perfect alignment. Grid spacing can be changed. Go to Properties from the Layout menu. The grids do not appear in the printout.

2.3 A view on a layout is displayed in a view frame that holds a representation of a specific view of your project. You can place several view frames into your layout and you can resize them as well to create the design you want. Click the Pointer tool to access View Frame Properties dialog box.

There is a live link between the view frame and the view. Changes on the view are automatically reflected on the layout. Map scale is automatic. As the size of the view frame in the layout is changed, the contents of the view frame will be scaled to fit inside the resized frame. Choose Preserve Scale from the Scale dropdown to keep the scale constant . Or choose User Specified Scale so that the content will be drawn according to your specifications.

2.4 Add components to your layout. To add a view, click on the View Frame tool. To add a scale, click the Scale Bar Frame tool. To add a legend, click on the Legend Frame tool. To add a north arrow, click on the North Arrow Frame tool. To add a chart, click on the Chart Frame tool. To add a table, click on the Table Frame tool. To add a picture, click on the Picture Frame tool. To add text, click on the Text tool. For graphics such as neatlines, boxes, circles, and arrows, there is the drawing tool in a dropdown palette that can be accessed by clicking on the Point tool.

2.5 Editing and rearranging what's on the layout. To change the properties of a frame, click the Pointer tool and double click inside the frame on the layout. You can resize any frame, text, or graphic on a layout by selecting it with the Pointer tool. The Simplify option converts the contents of a frame into a constituent parts so that you can edit these graphics individually. The command Simplify can be accessed from the Graphics menu. When you simplify the contents of a view or chart frame, the connection between the frame and view, table, or chat is broken and cannot be re-established.

2.5 To print the layout, access the File menu and select Print. The layout can be exported to a graphics file so that you can manipulate it in another graphics program, incorporate it into a report or powerpoint presentation in a different application. From the File menu, choose Export. In the dialog that appears, choose the File format you wish to export to and specify the name and location of the file that will be created. Note that for BSWM outputs, the layouts should be exported in PDF and JPEG formats.

Manual on Map Standards & Symbols for GIS. Elements of Map. Integrated Soil Resources Information Service and Cartogrpahic Operations Divsion. Bureau of Soils and Water Management (3): 13—15, 2009

Elements of Map

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1.0 Elements on all maps

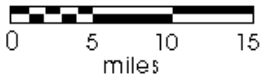
1.1 Distance or Scale

Scale is the ratio of reduction from the earth to the map. Distance and scale can be indicated in a variety of ways—verbal, numeric, or graphic form.

Examples:

1 inch equals 1 mile

1:25,000



1.2 Direction or Orientation

True north is the direction along the earth's surface towards the geographic North Pole. It differs from the magnetic north (the direction of the magnetic north pole) and the grid north (the direction northwards along the grid lines of a map). Without a north arrow, it is difficult to orient a map. Topographic maps will point to the true north and to magnetic north.

1.3 Legend

The legend is the lists of symbols used on a map and what they depict. These symbols should appear in the legend exactly as they are found in the body of the map.

1.4 Coordinates

These are represented by two sets of lines that are perpendicular to one another. Distance is expressed in degrees, minutes, and seconds of an arc.

Examples:

Latitude	14^{o} 30' 15"N
Longitude	121^{o} 25' 45" E

2.0 Essential elements that are sensitive to context

2.1 Map title

Map title is its most essential feature. The title provides a clue to the goal or purpose of the map. It should match the needs of the theme and the audience. It stands out among all annotations in terms of form and size of letter. Subtitle should be positioned right below the map title.

2.2 Projection

A map of the earth is a representation of a curved surface on a plane. Therefore a map projection have been used to create the map, and, conversely, maps could not exist without map projections. There are many types of projections and they can be classified based on aspect (cylindrical, conic, or azimuthal) or based on properties (conformal or neither). Every distinct map projection distorts in a distinct way. Because of this, projection influences the representation of the area, distance, direction, or shape. It is therefore important to specify the projection used in the map.

2.3 Date of production

It is also important for the map user to know when the map was produced. The date detail depends on the nature of the theme and the audience. For BSWM purposes, the month and year of production would suffice.

2.4 Sources of information and credit notes

The map should reflect all reference materials that were used in the preparation. Entities and individuals who helped contribute in the preparation of maps are given credit.

2.5 Producer's note

This is a note encouraging users who discover any errors or omissions to report them to proper mapping authorities to facilitate rectification and/or updating of the specific map.

3.0 Elements that are used selectively to assist effective communication

3.1 Neatlines

Neatlines or clipping lines are used to frame a map and to indicate exactly where the area of a map begins and ends. The outer neatline of a map--its border--helps to frame the entire map composition to draw the reader's attention to the

various elements of information. Neatlines are also used to "clip" the area of the body of the map and of locator, inset, and index maps.

3.2 Locator maps

Many maps portray areas whose locations may be unfamiliar to readers. In such cases, the cartographer adds a "helper" or locator map that places the body of the map within a larger geographical context with which the reader can be expected to be familiar.

3.3 Index maps

A specific map may be component of an atlas, or body of maps. For instance, the province of Laguna may consist of ten or more 1:50,000 soil maps. An index map is a finding aid that allows users search in a set of maps their area of interest in relation to the other relevant map sheets.

Mapping Symbology & Conventional Signs in ArcView

Integrated Soil Resources Information Service Staff
Bureau of Soils and Water Management

Mapping symbol standards will change as BSWM shifts to digital cartography. Because we no longer manually design the symbols, it is important for the mappers to know the available *choices* in the GIS software. Since map design is a creative process; as much as possible , we do not want to prescribe formats so as not to stifle the staff creativity and the sense of fulfilment of the map compositor.

However, we should also recognize that as a government institution, we need also to imprint the BSWM trademark on our map outputs. It means not only imprinting the BSWM logo but also stamping the BSWM style. Consistency of style is important as many technical as well as cartographic support staff are expected to produce and design maps. Constantly changing style sends a confusing message to our map users and decreases the authority of our maps as official outputs of BSWM. This manual was therefore conceived as the BSWM style book for maps.

ArcGIS 9.2 has a Style Manager. It contains default set of map elements, symbols, and properties of symbols. These can be edited to add personal style, and the BSWM style. As a general rule, map designers are free to express their creativity for map elements that are drawn. The software offers several styles to choose from. However, text and legend styles are prescribed to imprint on the map the BSWM style.

1.0 Map Scale

The ArcGIS 9.2 Desktop Help for setting map scale can be accessed at:

http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?Topicname=Setting_the_map_scale

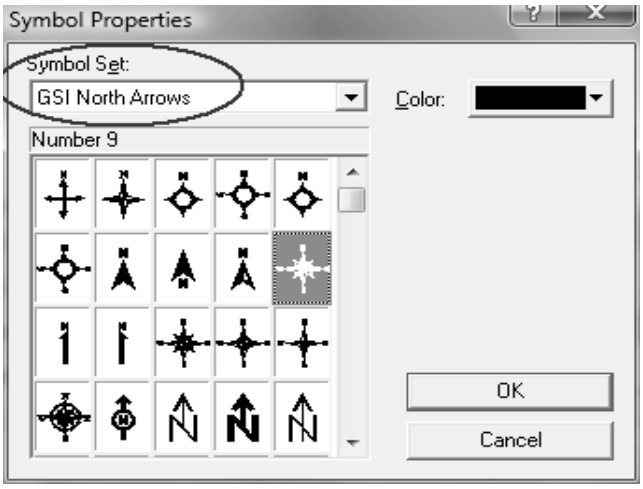
On the standard toolbar, click the Map Scale box to customize and select the scale format appropriate for the project. We do not prescribe specific format.

2.0 Direction or Orientation (North arrow)

To insert North Arrow element: Click the Insert menu, then click PLTS. Choose TLM, then North Arrow. The north arrow displays in the map layout. Double

click on the North Arrow to display the Properties dialog box. You can choose the area, size and position, and whether you want a true north, a grid north or a magnetic north. There are several choices of north arrow symbols from the north arrow palette library. We do not prescribe specific north arrow element drawing. Please refer to north.avp of the ArcView Symbol Palettes for the several choices of north symbol available. We leave it to the map compositor's personal choice.

Below is sample north arrow symbol selections from another GIS software (not ArcView) to show the symbol choices available. We leave it to the map compositor to select the specific symbol on the basis of artistic and personal preference.



3. Markers

Markers refer to geocoded point data, usually pit diggings and auger borings. As a matter of convention, the following are used:

Point data	Symbol	Source (ArcView)
Pit digging	☐	raster.avp—Marker Palette, no. 27, no. 55, no. 91, no. 92, usgs.avp no. 5
Auger boring, with sample	⊙	mineral.avp, no. 19 raster.avp no. 76, no. 77 water.avp no. 26
Auger boring, without sample	○	mineral.avp, no.0 raster.avp, no. 5, no. 74 no. 75 water.avp, no. 24

Fertility sample	△	mineral.avp, no. 36, raster.avp, no. 93, no. 94, water.avp, no. 29

For the other markers like schools, cemetery, airport, gasoline station, bus station, church, hospitals, NAPOCOR tower, market, mine, gym, restaurant, wildlife park, and a host of other institutional markers, the map compositors are free to select from among the myriad of choices available from the symbol palettes.

4.0 Line Specifications (please refer to ArcView pen palette library)

Line features like roads, coastline, rivers/creeks and political boundaries in addition to the frame border which is comprised of the borderline and neatline should be assigned or given a specific width and line style.

Analog cartography assigns a specific pen point size for borderline and neatline, political boundaries, road networks, railroad, and hydrography according to map scale.

During map digitization at ArcInfo, each of these lines are assigned specific ID numbers. When retrieving them in ArcView, there is a library of pen palette for specific line assignment to be given to each line feature.

Railroad line is no. 21 (simple railroad line, wide spacing of cross lines) or no. 22 (narrow spacing of cross lines) at the Pen Palette. The geology.avp no. 152 is also sign for railroad but colored red. Railroad can also be represented as alternating black and white bar (no. 10, no. 11, no. 12) or black and green bar (no. 26, no. 27) at the Pen Palette.

The traditional analog line for provincial boundary is equivalent to no. 5 at the Pen Palette. The municipal boundary is equivalent to no. 2. City boundary is no. 6. ArcView, however, offers several line palette choices; we are in a position to leave it to the map compositor to make judgment on what is logical to assign to the special line feature in terms of line symbol and line thickness; as long as these line assignments are properly put in the legend.

Likewise, there are several choices to choose from, for bridges. Line assignment for roads and trails can be selected at the Pen Palette for transportation. Map compositors have several choices for main roads and secondary roads, duplicating symbology used in road maps. There is no need to assign specific pen palette as long as the symbols are properly put in the legend.

We will also leave it to the map compositor to decide line assignment for hydrology features (rivers and creeks). Symbology for coral reefs (closest to existing analog symbol is no. 16, no. 17, or no. 18 at the carto.avp—Pen Palette with either

no. 41, no. 42, or no. 43, as fill in from carto.avp = Fill Palette) and for mapping boundary would depend on the judgment of the map compositor.

Map composition is a creative process and with several available choices for the map compositor in the GIS software, he becomes not only a resource scientist or a technical staff but also an artist.

5.0 Annotations

Current BSWM manual (analog) cartography defines specific pen point size and thickness for specific text annotations, in decreasing order of importance from map title, to sub-title, to names of barangays and conventional signs. Font size or pen class/thickness is standard (cannot be changed) and depends on map scale. The font type choices are limited to Roman (with serif) or Gothic (san serif).

In digital cartography, font choices are not limited to these two (there are several choices) and the font size can be defined according to the nature of the annotation. It is not the map scale that dictates the biggest and the smallest font size but the overall proportion as could be seen from the monitor, and as per artistic judgment of the map compositor. The frame, the text, or the graphic on a layout can be resized. **ArcView automatically retains the aspect ratio of the frame when resized.** Thus, it is irrelevant if the final output will be printed in A4, A3, A2, A1, or A0 paper size. Map element sizes will automatically adjust as the paper size is changed.

For purpose of defining BSWM style and uniformity in terms of letter type for the annotations, the following is the standard:

Map Feature	**Form**	**Font Size Ratio to other map features***	***Sample* Font Size**
Map Title	All caps, Bold	1.0 (biggest font size)	32
Sub Title	Upper and lower case	0.82	28
Province/Region under consideration	All caps	0.28	16
Municipality	Upper and lower case	0.24	12
Adjacent Province/Region	All caps, parallel to line of latitude	0.28	16
Conventional Signs			
1. Title	All caps	0.28	16
2. Explanation of symbols	Upper and lower case	0.24	12
3. Bar Scale	All caps	0.24	12
4. Coordinates– Latitude	10^{o} 15'N	0.18	10
Longitude	117^{o} 45' E	0.18	10
5. Open water (ocean, sea, gulf)	All caps, *Italic*	0.14	6
6. Running water (river, creek)	Upper and lower case, *Italic*	0.14	6
Legend			
1. Legend Title	All caps	0.33	24
2. Content of legend	Upper and lower case	0.24	16

**Based on pen class standard for analog maps. The figures are based on the proportion of other annotation (font) sizes with the biggest font size (i.e., the map title) given a score of 1. This is not a hard rule, but a guide that for instance, font size for the name of municipality, explanation of symbols, the bar scale, and the content of map legend are the same. Map compositors should consider the overall effect when deciding the biggest font size.*

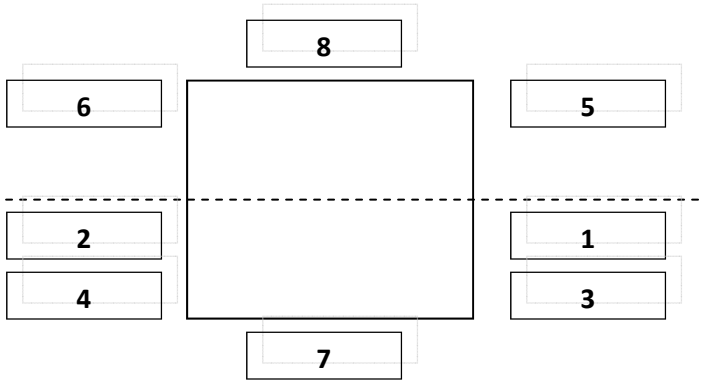
Theme's features in ArcView can be labelled from any of the fields in the theme's attribute table. Additional information can be added by typing text directly into the map. Use ArcView's drawing tools to add graphics. Text and graphics can also be attached to a theme and they will appear on the map when the theme is on. Another way to provide information is to add "*hot links"* on features so that when an specific feature is clicked, ArcView will automatically display images, photographs, documents, drawings, video clips, or any other information stored in separate files.

To add text on the map, click the Text tool and click where you want to place the text. A dialogue box appears , type in the text you want to add, choose the desired alignment, line spacing, and rotation. Click OK and the text appears on the map.

Use ArcView's drawing tools to add graphics such as lines, boxes, circles and arrows to the map. The drawing tools are in drop-down pallete that can be accessed by clicking on the Point tool. To change the appearance of the graphic, choose Show Symbol Window, and click the button for the property you wish to change.

To edit the text, click on the text with the Text tool or double click with the pointer tool. To change the font, size, and style of text—choose Show Symbol Window from the Window menu. Choose Font Style, or Color Pallet button, or both.

5.1 Order of Preference in name positioning for labelling of individual features (BSWM style)

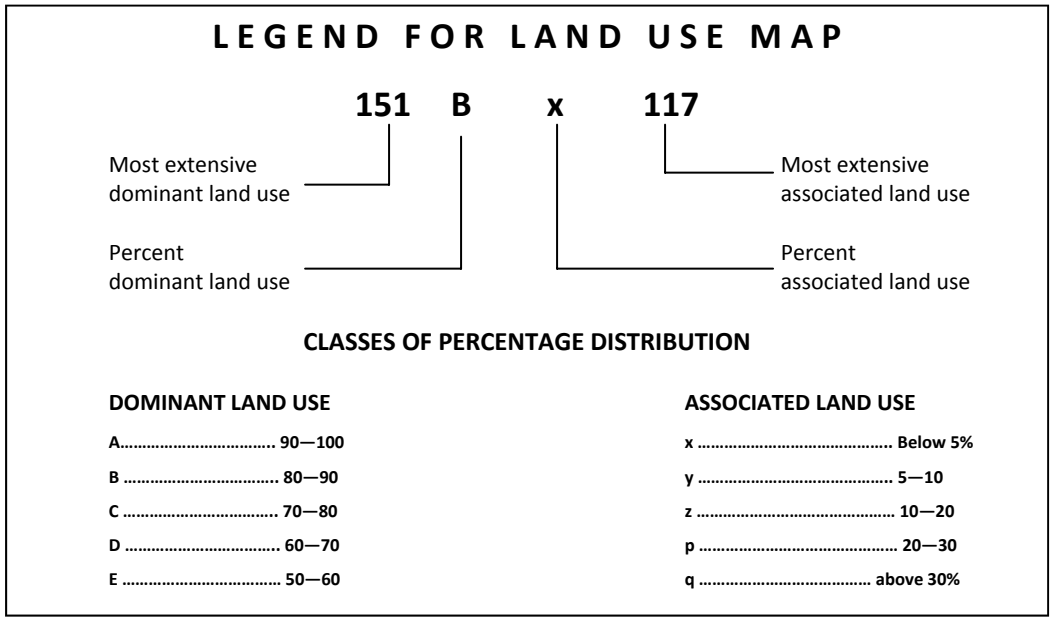


There is auto-label option in the Theme menu to label all the features in a theme. Select the features with the mouse, use the Select Features tool. To select the

features according to their attributes, use the Query Builder. If you allow overlapping, check the Allow Overlapping Labels option. ArcView keeps track of overlapping labels and displays them in green color to find them easily. Such labels can be moved or rotated to better location.

Standard Codes for Thematic Mapping

Cartographic Operations Division Staff/ Soil Survey Division Staff
Bureau of Soils and Water Management
Elliptical Road, Diliman, Quezon City



1.0 Land Use Standard Mapping Codes

Code	Crops
	Grain crops (1-10)
1	Paddy rice (irrigated)
2	Paddy rice (non-irrigated)
3	Upland rice
4	Corn
5	Sorghum
6	Rye
7	Wheat
	Pod legumes (11-20)
11	Mungo
12	Peanut
13	Soybeans
14	Lima beans
15	Cowpea

16 Peas
17 Patani
18 Tapilan

Vegetables, fruit type (21-35)

21 Eggplant
22 Tomato
23 Sitao (string beans)
24 Ampalaya
25 Patola
26 Squash
27 Upo
28 Okra
29 Winged beans
30 Kundol
31 Chayote
32 Sweet pepper
33 Batao

Vegetables, leafy (36-50)

36 Cabbage
37 Pechay
38 Cauliflower
39 Mustard
40 Lettuce
41 Celery
42 Spinach
43 Talinum
44 Jute
45 Malunggay
46 Kangkong

Root crops (51-65)

51 Cassava
52 Sweet potato
53 Irish potato
54 Ube
55 Tugi
56 Yam
57 Arrowroot
58 Turnips (singkamas)
59 Ginger

Bulbs (66-70)

66 Onion
67 Garlic

Vines, fruit type (71-80)

71 Cucumber

72	Watermelon
73	Melon
74	Grapes
74	Strawberry
	Tree crops, fruits (81-105)
81	Coffee
82	Cacao
83	Citrus
84	Pineapple
85	Mango
86	Cashew
87	Jackfruit
88	Lanzones
89	Durian
90	Pomelo
91	Banana
92	Santol
93	Mangosteen
94	Chico
95	Chesa
96	Papaya
97	Guava
98	Rambutan
99	Caimito (star-apple)
100	Avocado
101	Mabolo
102	Marang
103	Atis
104	Bread fruit
105	Mixed fruit trees
	Fiber crops (106-110)
106	Maguey
107	Abaca
108	Cotton
109	Sisal
110	Ramie
	Industrial crops (111-115)
111	Tobacco
112	Sugarcane
	Oil crops (116-125)
116	Coconut (B)
117	Coconut (NB)
118	Sunflower
119	Oil palm
120	Castor bean
121	Jatropha

	Grassland (126-130)
126	Grassland
127	Pasture
128	Pasture/livestock
129	Yemani
	Shrub (131-135)
131	Ipil-ipil
132	Madre de cacao
133	Bamboo
134	Shrubs
135	Agro-forestry
	Woodland, forest type (136-140)
136	Forest
137	Rubber tree (T)
138	Rubber tree (NT)
139	Falcata
140	Pine tree
	Wetland (141-150)
141	Mangrove, palm tree
142	Mangrove, tree type
143	Inland marsh, tree type
144	Inland marsh, grass type
145	Fresh water swamp
146	Salt bed
147	Fishpond
	Special Land Use (151-162)
151	Built areas
152	Beach sand
153	Sand dune
154	Mine pit
155	Quarry
156	Kaingin
157	Airport
158	River wash
159	Rock land
160	River and lake
161	Volcano
162	Reservoir

2.0 Land Use Distribution Class

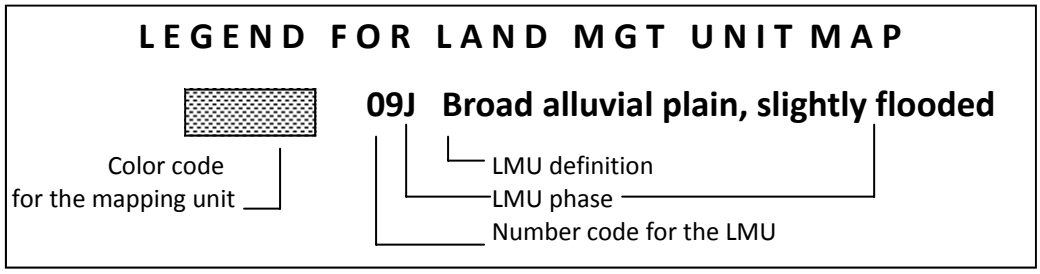
Code	**Percentage Distribution**
	(Dominant Land Use)
A	90-100
B	80-90

C	70-80
D	60-70
E	50-60
F	40-50
	(Associated Land Use)
x	<5
y	5-10
z	10-20
p	20-30
q	>30

3.0 Geomorphic Mapping Units (GMU)

Code/Symbol	**GMU**
CP	Coastal Plain
BAP	Broad Alluvial Plains
MAP	Minor Alluvial Plains
FP	Footslope (Piedmont)
PLP	Plateau Limestone Plain
LH	Limestone Hills
SSH	Sand Stone and Shale HIlls
CH	Conglomerate Hills
PH	Pyroclastic Hills
BH	Basaltic Hills
AH	Andesitic Hills
VCH	Volcanic Complex Hills
UH	Ultra Basic Hills
VAH	Volcanic Agglomerate Hills

4.0 Land Management Units (LMUs)



Lowland LMUs

Slope: 0-8%
Elevation: <100 masl
Temperature: >25^{o}C

Code	Description
01	Active tidal flats (developed fishpond/salt bed)
02	Active tidal flats (natural mangrove/nipa)
03	Swamps (tree type)
04	Marshes (grassy type)
05	Inland water lakes
08	Beach ridges and swales
09	Broad alluvial plain
10	Former/old tidal flats
11	River levees
12	Lower river terraces
13	Upper river terraces
14	Mini plain
15	Lacustrine plain
16	Infilled/localized valley
17	Inland/enclosed valleys
18	Collo-alluvial plain
19	Narrow alluvial plain (width <500 meters)
21	Karst/sinkholes
22	Limestone karst plain, lower terraces
23	Limestone karst plain, upper terraces
24	Tuffaceous plain
25	Volcanic plain/residual terraces
26	Lower footslopes (shale, sandstone hills)
27	Lower piedmont plains/footslopes (volcanic hills)
28	Lower footslopes (limestone hills)
29	Lower footslopes (volcanic hills)

Upland LMUs:

Slope: <18%
Elevation: 100-150 masl
Temperature: 22.5^{o}C—25^{o}C

Code	Description
40	Lower river terraces
41	Upper river terraces
42	Mini plain
43	Broad alluvial valleys
44	Infilled localized valleys
45	Inland stream/enclosed valleys
46	Collo-alluvial plain
47	Narrow alluvial plain
48	Residual terraces, level to gently sloping
49	Residual terraces, sloping to undulating

50 Residual terraces, undulating to rolling
51 Lower footslopes (volcanic)
52 Lower footslopes (shale/sandstone)
53 Upper footslopes (volcanic hills)
54 Upper footslopes (shale/sandstone hills)
55 Lower footslope—volcanic cones
56 Foothills/intervalleys
57 Intermountain valleys
58 Tuffaceous plain
61 Solutional depression (Karst valley, sink hole)
62 Limestone/Karst, lower terrace
63 Limestone/Karst, upper terrace
64 Limestone hills, lower coral terrace
65 Limestone hills, upper coal terrace
66 Low limestone hills
67 Karst plateau
68 Shale sandstone plateau
72 Pluralistic plateau
74 Volcanic complex plateau
75 Shale/sandstone plateau
76 Low shale/sandstone hills
77 Low conglomeratic hills
78 Low pyroclastic hills
79 Low basaltic hills
80 Low volcanic complex hills
81 Low volcanic agglomerate hills
82 Low andesitic hills
83 Low dioritic hills
85 Low granitic hills
86 Low meta-sedimentary hills
87 Low meta-volcanic hills
88 Low metamorphic hills
89 Low ultra-basic hills
90 Low meta-rock complex hills
91 Low sedimentary unconsolidated conglomerate shale
92 Low tilted interbedded hills
93 Low complex sedimentary hills

Hilly land LMUs

Slope: >18%
Temperature: 22.5—25.0^{o}C
Elevation: 100 – 500 masl

110 Association of volcanic hills with slope ridges and scattered limestone hills with solutional depression
111 High limestone hills

112	High shale-sandstone hills
113	High conglomeratic hills
114	High pyroclastic hills
115	High basaltic hills
116	High andesitic hills
117	High volcanic complex hills
118	High ultra basic hills
119	High volcanic agglomerate hills
120	High dioritic hills
123	High meta-sedimentary hills
124	High meta-volcanic hills
125	High metamorphic hills
126	High meta-rock complex hills
128	High sedimentary unconsolidated conglomeratic shale and corraline limestone including foothills and ridges of intermediary alluvial valleys
129	High volcanic cone

Highland LMUs

Regardless of slope
Elevation: >500 masl
Temperature: <22.0^{o}C

140	Inter-montane valleys
141	Piedmont plains/footslope (volcanic mountain)
142	Lower footslope (volcanic mountain)
143	Upper footslope (volcanic mountain)
144	Limestone plateau
145	Shale stone plateau
146	Shale/sandstone plateau
147	Basaltic plateau
148	Pyroclastic plateau
149	Ultrabasic plateau
150	Tuffaceous

Miscellaneous Units

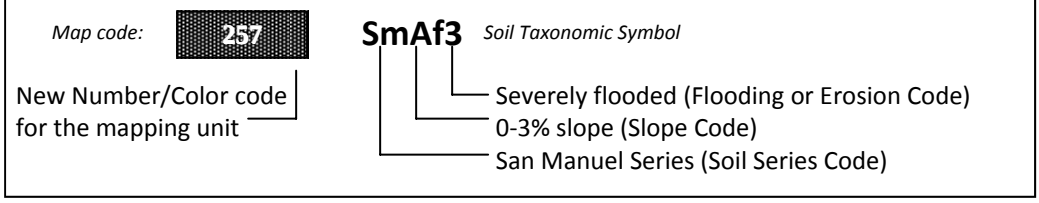
180	Built-up areas / urban land
181	Braided river bed
182	Sand dunes
183	Sand bars / beach sand
184	Rockland
187	Tailing pond
189	Canyon and gorges
190	Quarry
191	Creek/ terrace escarpment
193	Major river

LMU Phases

Code	**Description**
Soil depth	
A	Shallow soil depth, <50 cm
B	Moderately deep, 50-100 cm
C	Deep to very deep, > 100 cm
Soil textural group	
D	Coarse textured soils (sands, loamy sands, gravel)
E	Medium textured soils (sandy loam, silt loam, loam, silty clay loam, sandy clay loam, organic mud)
F	Heavy textured soils (clay to heavy clay, silty clay to silty heavy clay, sandy clay to sandy heavy clay
Drainage	
G	Excessive drainage
H	Well drained
I	Poorly drained
Flooding	
J	None to slight flooding—flood water at depth of <0.5 m for a duration of 1-2 days or less with receding period of not later than 6 hours
K	Moderate flooding—flood water at depth of 0.5—1.0 m for a duration of 1-2 days or less with receding period of not later than 6—24 hours
L	Severe flooding—flood water at depth of 1.0—1.5 m with duration lasting for 3 days or more and recedes in > 24 hours
Slope	
M	0-3% slope—level to gently sloping
N	3-8% — gently sloping to undulating
O	8-18% — undulating to hilly
P	18-30% — rolling to hilly
Q	30-50% — steep hills to mountainous
R	> 50% — cliff-like streams/mountainous
Dissection	
S	Slight dissection—average distance between 2 adjacent drainage lines (gullies, streams) is 50 m
T	Moderate dissection—average distance between 2 adjacent drainage lines (gullies, streams) is 25-50 m
U	Severe dissection—average distance between 2 adjacent drainage lines (gullies, streams) is <25 m
Relief classification (for hilly landforms)	
V	Low relief—10-100 m.a.s.l.
W	High relief—100-500 m.a.s.l.

Note: Landforms with relief more than 500 meters is considered mountainous

LEGEND FOR SOIL SERIES MAP



Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Abatan	At	317	01	Bontoc
Abo	Ab	-	02	Laguna
Aborlan	Abl	15	03	Palawan
Adtuyon	Ad	137	04	Bukidnon
Agustin	Ag	-	05	Nueva Vizcaya
Alaminos	Al	38	06	Pangasinan
Alimodian	Ald	46	07	Iloilo
Alipit	Alp	-	08	Laguna
Ambassador	Am	291	09	Benguet
Ana-aon	Ao	276	10	Surigao del N
Angeles	Ag	28	11	Pampanga
Annam	An	35	12	Nueva Ecija
Antipolo	Ap	14	13	Rizal
Arayat	At	30	14	Pampanga
Aroman	Ar	199	15	Cotabato
Atok	Ak	296	16	Benguet
Awayan	Ay	-	17	Bulacan
Babuyan	Bay	60	18	Palawan
Bad-as	Bd	280	19	Surigao del N
Bago	Ba	124	20	Negros Occ
Baguio	Bg	69	21	Mt. Province
Bagumbayan	Bgm	-	22	Laguna

**Old number code for every provincial soil map where the soil series occurs is based on soil series types/phases and could be more than one assigned per soil series (e.g., Adtuyon clay- 323; Adtuyon clay, stony phase- 324). New number code is to be assigned permanently to soil series, and the soil types and phases are to be given different codes. Yet to be digitized old analog maps should follow new number codes. Updated soil maps do not have number codes.*

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Bakakeng	Bkg	300	23	Benguet
Balacbac	Bb	295	24	Benguet
Balanacan	Bc	177	25	Marinduque
Baler	Bl	239	26	Quezon
Baliangao	Bo	224	27	Misamis Occ
Balili	Bi	297	28	Benguet
Balog	Blg	-	29	Ifugao
Balongay	By	79	30	Camarines Sur
Baluarte	Blt	77	31	Bohol
Balut	Bu	160	32	Bohol
Bancal	Bc	66	33	Zambales
Banga	Bn	34	34	Cotabato
Banhigan	Bh	168	35	Marinduque
Bani	Bni	39	36	Pangasinan
Barang	Br	-	37	Pangasinan
Bantay	Bty	70	38	Ilocos Sur
Batia	Bti	-	39	Bulacan
Banto	Bto	170	40	Marinduque
Bantog	Bt	9	41	Bulacan
Baras	Brs	-	42	Rizal
Barcelona	Brc	56	43	La Union
Barotac	Btc	48	44	Iloilo
Bascaran	Bcr	110	45	Albay
Basco	Bco	182	46	Batanes
Batuan	Btu	74	47	Bohol
Bay	Bay	12	48	Laguna
Baybay	Bby	-	49	Laguna
Bayho	Bho	201	50	Samar
Bauang	Bun	44	51	La Union
Bauyan	Byn	271	52	Lanao
Beach Sand	*BCS*	*118*	*604*	*Palawan*

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Beneng	Be	288	53	Benguet
Bigaa	Big	3	54	Bulacan
Binangonan	Bng	13	55	Rizal
Binidayan	Bdy	270	56	Lanao
Bituin	Bu	218	57	Abra
Boac	Boa	178	58	Marinduque
Bobok	Bk	302	59	Benguet
Bodies of water	*WB*	-	*675*	-
Bog, deep	*BOG*	*593*	*646*	*Cagayan*
Bolaoen	Bln	276	60	Zamboanga S
Bolinao	Bo	40	61	Pangasinan
Bolog	Bog	304	62	Ifugao
Boulevard	Bou	-	63	Rizal
Brooke's	Brk	71	64	Palawan
Buayan	Buy	138	65	Cotabato
Buenavista	Bvt	6	66	Bulacan
Bugarin	Bgr	-	67	Rizal
Bugko	Bko	169	68	Samar
Bugnan	Bgn	973	69	Lanao
Buguey	Bug	195	70	Cagayan
Bulaoen	Be	67	71	Zambales
Buldon	Bld	161	72	Cotabato
Bulubog	Bbg		73	Laguna
Bulusan	Bsn	118	74	Sorsogon
Burgos	Brg	59	75	La Union
Busuanga	Bsg	196	76	Palawan
Butuan	Btn	222	77	Agusan
Buyagan	Byg	287	78	Benguet
Buyogan	Bon	283	79	Zamboanga S
Cabahuan	Ch	179	80	Marinduque
Cabanbanan	Cbb	-	81	Laguna

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Cabangan	Cb	65	82	Zambales
Cabantian	Ct	93	83	Davao
Cadiz	Cz	126	84	Negros Occ
Calantas	Cl	-	85	Rizal
Calape	Ce	73	86	Bohol
Calatagan	Cg	231	87	Catanduanes
Calauaig	Clg	141	88	Bukidnon
Calawit	Cw	252	89	Zamboanga S
Calumpang	Cn	21	90	Batangas
Camachile	Cm	234	91	Pampanga
Camansa	Cs	95	92	Davao
Camarin	Cmr	-	93	Rizal
Camiguin	Cmg	136	94	Misamis Or
Candaba	Cd	27	95	Pampanga
Candijay	Cj	15	96	Bohol
Canlalay	Cly	-	97	Laguna
Capipisa	Cp	323	98	Cavite
Carig	Cr	197	99	Cagayan
Carmona	Ca	18	100	Cavite
Caromatan	Crt	227	101	Lanao
Casiguran	Csg	116	102	Sorsogon
Castilla	Cta	114	103	Sorsogon
Cataingan	Ctg	142	104	Masbate
Catanauan	Ctu	240	105	Quezon
Catbalogan	Cbg	192	106	Samar
Catubig	Ctb	193	107	Samar
Catuno	Cno	235	108	Pampanga
Cauyan	Cyn	198	109	Isabela
Cervantez	Cv	99	110	Ilocos Sur
Coralan	Crl	-	111	Laguna
Corgante	Crg	-	112	Bulacan

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Coron	Co	42	113	Palawan
Culis	Cu	53	114	Bataan
Cupang	Cpg	-	115	Rizal
Daclan	Dl	293	116	Benguet
Dadiangas	Dd	148	117	Cotabato
Dagami	Dg	89	118	Leyte
Dahinub	Db	727	119	Zamboanga N
Dalican	Dc	149	120	Cotabato
Dauin	Da	145	121	Negros Or
Dinagat	Dtg	281	122	Surigao del N
Dita	Dta	-	123	Laguna
Dohinob	Dh	219	124	Zamboanga N
Dolongan	Do	206	125	Samar
Dolores	Dr	202	126	Marinduque
Donsol	Ds	115	127	Sorsogon
Dumbal	Dm	284	128	Zamboanga Z
Dune Land	*DNL*	*594*	*610*	*Ilocos Norte*
España	Ep	251	129	Romblon
Faraon	Fa	49	130	Negros Occ
Filled-up soils	*FIL*	*29*	*631*	*Rizal*
Gapan	Gpn	-	131	Bulacan
Gasan	Ga	153	132	Marinduque
Glan	Gl	150	133	Cotabato
Gravel deposits	*GRV*	*149*	*605*	*La Union*
Guadalupe	Gd	10	134	Rizal
Guimaras	Gs	51	135	Iloilo
Guimbalaon	Gb	90	136	Negros Occ
Guinaoang	Gu	301	137	Benguet
Guinobatan	Gn	113	138	Albay
Guintabuan	Gt	132	139	Negros Occ
Gullied Land	*GDL*	*611*	*611*	-

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Halsema	Ha	292	140	Benguet
Halayhayin	Hyh	-	141	Laguna
Hernani	Hi	190	142	Samar
Himayangan	Hy	88	143	Leyte
Hydrosols	*HYD*	*1*	*632*	-
Ibaan	Ib	23	144	Batangas
Ilagan	In	191	145	Isabela
Inabanga	Ig	76	146	Bohol
Inarawan	Inr	-	147	Rizal
Indan	Id	81	148	Camarines N
Irosin	Ir	120	149	Sorsogon
Isabela	Is	123	150	Negros Occ
Jalajala	Jl	-	151	Rizal
Jamoyaon	Jm	275	152	Surigao del N
Jasaan	Js	135	153	Misamis Or
Kabacan	Kb	151	154	Cotabato
Kabatohan	Kh	268	155	Surigao del N
Kalayakan	Kyk	-	156	Bulacan
Kamandag	Km	212	157	Negros Occ
Kapalangan	Kp	-	158	Bulacan
Kapatagan	Kg	258	159	Lanao del N
Kay Bamban	Kb	-	160	Bulacan
Kay Barbon	Kbo	-	161	Rizal
Katubleng	Kt	294	162	Benguet
Kaunayan	Ky	181	163	Marinduque
Kidapawan	Kd	9	164	Cotabato
Kitcharo	Kr	144	165	Agusan
Kudarangan	Kd	162	166	Cotabato
Labason	Ls	220	167	Zamboanga N
La Castellana	Lc	127	168	Negros Occ
Lagawe	Lw	306	169	Ifugao

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Lala	La	257	170	Lanao del N
Lamut	Lm	310	171	Ifugao
Landslides	*LSL*	*613*	*613*	-
Langa	Lng	1050	172	Ifugao
Langkong	Lk	163	173	Cotabato
Lapaz	Lp	29	174	Pampanga
La Trinidad	Ld	299	175	Benguet
Lava Flows	*LVF*	*614*	*614*	-
Lawigan	Lwg	278	176	Zamboanga N
Laylay	Ly	172	177	Marinduque
Legaspi	Le	106	178	Albay
Legua	Leg	213	179	Negros Occ
Libertad	Lb	183	180	Samar
Libi	Lib	152	181	Cotabato
Libon	Lbo	108	182	Albay
Ligao	Lig	109	183	Albay
Limestone RockLand	*LMR*	*581*	*627*	*Zambonaga N*
Lipa	Li	24	184	Batangas
Longa	Ln	305	185	Ifugao
Lonos	Lo	249	186	Romblon
Looc	Loc	-	187	Laguna
Lourdes	Lr	134	188	Misamis Or
Lubigan	Lub	1022	189	Zamboanga S
Lugo	Lg	61	190	Cebu
Luisiana	Lu	47	191	Laguna
Luisita	Lt	32	192	Tarlac
Lumbangan	Lum	-	193	Rizal
Lupa	Lup	-	194	Laguna
Lutayan	Lty	173	195	Cotabato
Maahas	Mh	226	196	Laguna
Maapag	Mp	139	197	Bukidnon

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Maasin	Ms	87	198	Leyte
Mabini	Mb	223	199	Misamis Occ
Macabare	Mc	117	200	Sorsogon
Macolod	Md	55	201	Batangas
Madunga	Mdg	97	202	Davao
Magallanes	Mg	16	203	Cavite
Magcalon	Mgc	100	204	Antique
Magsaysay	My	232	205	Mindoro Occ
Mahipon	Mhp	-	206	Bulacan
Mailag	Mi	140	207	Bukidnon
Makar	Mkr	155	208	Cotabato
Makato	Mo	102	209	Capiz
Malabang	Mlb	269	210	Surigao del S
Malalag	Ml	98	211	Davao
Malandag	Mlg	442	212	Cotabato
Maligaya	Ma	41	213	Nueva Ecija
Malimono	Mn	273	214	Surigao del N
Malinao	Mlo	107	215	Albay
Malitbog	Mlt	86	216	Leyte
Mambajao	Mj	133	217	Misamis Or
Mambutay	Mbt	185	218	Agusan
Manapla	Mpl	128	219	Negros Occ
Managok	Mgk	-	220	Bukidnon
Mandawe	Mw	62	221	Cebu
Maningkulat Peat	Mkt	559	222	Sulu
Mantalongon	Mto	64	223	Cebu
Maranlig	Mrg	174	224	Marinduque
Marikina	Mk	11	225	Rizal
Masantol	Mst	-	226	Bulacan
Matho	Mth	267	227	Surigao del S
Matina	Mna	91	228	Davao

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Matimbo	Mt	-	229	Bulacan
Matulas	Mtl	164	230	Cotabato
Matuya-tuya	Mty	156	231	Marinduque
Mauraro	Mro	111	232	Albay
Mayan	Myn	184	233	Batanes
Maydolong	Mdl	175	234	Samar
Mayon	Myo	112	235	Albay
Masao	Mso	-	236	Davao
Mayoyao	Myo	309	237	Ifugao
Maytalatala	Mat	-	238	Rizal
Medellin	Me	63	239	Cebu
Mirador	Mrd	303	240	Benguet
Miral	Mi	94	241	Davao
Mogpog	Mp	176	242	Marinduque
Mtn soils, undiff	*MTS*	*45*	*645*	-
Muzon	Mz	321	243	Cavite
Mysan	Mys	-	244	Bulacan
Nambaran	Nb	318	245	Kalinga Apayao
Nangalisan	Ng	289	246	Benguet
Natonin	Nt	314	247	Bontoc
Natubleng	Nbg	1039	248	Benguet
Nayon	Ny	308	249	Ifugao
New Iloilo	Nl	165	250	Cotabato
Novaliches	Nv	7	251	Bulacan
Nupol	Np	166	252	Cotabato
Obando	Ob	2	253	Bulacan
Odiongan	Od	247	254	Romblon
Paete	Pt	54	255	Laguna
Palapag	Pg	186	256	Samar
Palitod	Pld	312	257	Bontoc
Palo	Pl	83	258	Leyte

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Palompon	Po	85	259	Leyte
Panobatan	Pnb	279	260	Zamboanga del N
Panganiran	Pag	171	261	Albay
Pangasinan	Pn	233	262	Pangasinan
Pangil	Pgl	-	263	Laguna
Pantao	Pto	237	264	Sulu
Panupdupan	Pnd	307	265	Ifugao
Paoay	Py	298	266	Benguet
Paradise	Pds	-	267	Bulacan
Parang	Prg	167	268	Cotabato
Pasil	Ps	188	269	Sulu
Pasonanca	Psc	187	270	Zamboanga
Patnongon	Ptg	101	271	Antique
Patungan	Pta	19	272	Cavite
Pawing	Pw	82	273	Leyte
Penaranda	Prd	-	274	Bulacan
Philscomsat	Phs	-	275	Rizal
Pilar	Pa	52	276	Bataan
Pili	Pl	78	277	Camarines S
Pinagbuhatan	Pgh	-	278	Rizal
Pinugay	Pny	-	279	Rizal
Piris	Pi	241	280	Quezon
Polillo	Po	242	281	Quezon
Prensa	Pr	5	282	Bulacan
Puguis	Pu	286	283	Benguet
Pulong Buhangin	Pb	-	284	Bulacan
Pulupandan	Pd	122	285	Negros Occ
Quilada	Qd	216	286	Cotabato
Quingua	Qg	4	287	Bulacan
Ramain	Rm	261	288	Lanao S
Riverwash	*RW*	*152*	*600*	*Abra*

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Riverwash, gravelly	*RWG*	*60*	*601*	-
Riverwash, sandy	*RWS*	*602*	*602*	-
Rizal	Rz	256	289	Quezon
Rock Lands	*RKL*	*599*	*622*	*Cagayan*
Rock Outcrop	*RKO*	*623*	*623*	-
Romblon	Rb	246	290	Romblon
Rough broken land	*RBK*	*326*	*624*	*Bukidnon*
Rough mt'n land	*RMT*	*202*	*625*	*Palawan*
Rough stony land	*RSL*	*171*	*629*	*Abra*
Rubble land	*RBL*	*366*	*626*	*Agusan*
Rugao	Ru	189	291	Isabela
Rugnan	Rg	260	292	Lanao del S
Sabangan	Sbg	316	293	Bontoc
Sabtang	Sbt	690	294	Batanes
Sagada	Sg	315	295	Bontoc
Sala	Sl	-	296	Laguna
Salaman	San	259	297	Lanao del S
Sampaloc	Smp	-	298	Rizal
Sand and coral bed	*SCB*	*595*	*633*	*Ilocos Norte*
Sand dunes	*DNL*	*594*	*610*	*Cagayan*
San Fabian	Sfb	37	299	Pangasinan
San Fernando	Sf	26	300	Pampanga
San Francisco	Sfc	-	301	Laguna
San Juan	Sj	204	302	Isabela
San Luis	Sls	-	303	Rizal
San Manuel	Sm	31	304	Tarlac
San Rafael	Sr	50	305	Iloilo
Sapa	Sp	277	306	Surigao del N
Sapian	Sn	105	307	Capiz
Sara	Sar	45	308	Iloilo
Sariaya	Sry	243	309	Quezon

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Sevilla	Sv	72	310	Bohol
Siari	Sri	205	311	Zamboanga N
Siain	Sin	244	312	Quezon
Siaton	Si	146	313	Negros Or
Sibul	Sb	8	314	Bulacan
Sigcay	Sgk	103	315	Capiz
Silay	Sly	121	316	Negros Occ
Sinapangan	Spg	58	317	La Union
Sinolon	Snl	207	318	Cotabato
Sison	Sis	272	319	Surigao del N
Soils undifferentiated	*SLU*	-	*647*	-
Songsong	Son	313	320	Bontoc
Sorsogon	Sor	119	321	Sorsogon
Sta. Fe	Se	250	322	Romblon
Sta. Filomena	Sa	580	323	Sulu
Sta. Maria	Sma	311	324	Ifugao
Sta. Rita	St	43	325	Iloilo
Stony Land	*STL*	*629*	*628*	-
Surigao	Su	274	326	Surigao del N
Swamps	SWP	630	630	-
Taal	Ta	22	327	Batangas
Tacdian	Tcd	290	328	Benguet
Tacloban	Tb	84	329	Leyte
Tadao	Td	215	330	Ilocos Norte
Tagaytay	Tg	17	331	Cavite
Tagburos	Tgb	57	332	Palawan
Tagkawayan	Tky	245	333	Quezon
Tagulod	Tgd	-	334	Bulacan
Tagum	Tgm	208	335	Marinduque
Tamontaka	Tmk	157	336	Cotabato
Tapul	Tpl	20	337	Palawan

Soil Series Name	Soil Series Code	Old No. Code	New No. Code*	Origin
Tarlac	Tr	25	338	Tarlac
Tarug	Trg	159	339	Marinduque
Taway	Tw	1026	340	Zambaonga S
Teresa	Ts	-	341	Rizal
Tigaon	Ti	80	342	Camarines Sur
Tilik	Tk	229	343	Mindoro Occ
Timaga	Tm	158	344	Cotabato
Timbo	To	180	345	Marinduque
Tingib	Tn	200	346	Samar
Tiptipon	Tpo	228	347	Sulu
Titay	Tay	214	348	Zamboanga S
Toran	Tor	203	349	Cagayan
Tugbok	Tuk	92	350	Davao
Tuguis	Tu	248	351	Romblon
Tulay	Tly	-	352	Rizal
Tupi	Tp	129	353	Cotabato
Tutulo	Tlo	-	354	Rizal
Ubay	Ub	104	355	Bohol
Umingan	Um	36	356	Pangasinan
Uyugan	Uy	-	357	Batanes
Unclassified islands	*UCI*	-	*680*	-
Unsurveyed areas	*USV*	-	*681*	-
Uyugan	Uy	209	358	Batanes
Victorias	Vt	125	359	Negros Occ
Villar	Vi	68	360	Zambales
Virac	Vr	230	361	Catanduanes
Zamboanguita	Zb	147	362	Negros Or
Zaragosa	Zr	33	363	Nueva Ecija

Soil Complexes

Note: Additional, proposed, as well as new soil series/soil complexes should be coordinated with Soil Survey Division for assignment of new number code. A soil complex is a soil association composed of two or more soil series, types, or phases which occur intricately and could not be mapped separately at the given map scale. The soil complex bears the name of the dominant soil series.

Soil Complex Name	Old No. Code	New No. Code*	Origin
Adtuyon-La Castellana	1007	1001	Lanao N; Lanao S
Alaminos-Antipolo	1028	1002	Zamboanga del S
Alimodian-Barotac	125	1003	Capiz; Iloilo
Alimodian -Bolinao	707	1004	Antique
Alimodian-Castilla	1029	1005	Zamboanga del S
Antipolo-Alimodian-Luisiana	181	1006	Camarines Sur
Antipolo-Bolaoen	1030	1007	Zamboanga del S
Bantay-Bauang	402	1008	Nueva Vizcaya
Banto-Malalag	865	1009	Mindoro
Batuan-Faraon	179	1010	Bohol
Bolinao-Pasonanca-Dahinub	1016	1011	Zamboanga del N
Burgos-Guimbalaon	-	1012	Nueva Vizcaya
Burgos-Luisiana	-	1013	Nueva Vizcaya
Castilla-Bolinao	342	1014	Sorsogon
Faraon-Bolinao	201	1015	Southern Leyte
Faraon-Pasonanca	1027	1016	Zamboanga del S
Guimbalaon-Annam	524	1017	Nueva Vizcaya
Jasaan-Bolinao	321	1018	Misamis Oriental
La Castellana-Luisiana-Jasaan	1017	1019	Zamboanga del S
Luisiana-Annam	404	1020	N. Vizcaya; Qurino
Luisiana-Jasaan	1018	1021	Zamboanga del S
Macolod-Pili	187	1022	Albay; Camarines S
Malalag-Faraon	944	1023	Romblon
Manapla-Bago	272	1024	Negros Occidental
Pasil-Adtuyon	553	1025	Sulu; Tawi-tawi

Soil Complex Name	Old No. Code	New No. Code*	Origin
San Manuel-Taal	414	1026	Negros Oriental
Tarug-Burgos	-	1027	Nueva Vizcaya
Tarug-Faraon	515	1028	Marinduque
Tarug-Guimbalaon	-	1029	Nueva Vizcaya
Tingib-Catbalogan	493	1030	W. Samar; E. Samar

Miscellaneous Land Types

Miscellaneous Land Types	Letter Code	Old No. Code	New No. Code*	Origin
Riverwash	RVW	152	600	Abra
Riverwash, gravelly	RWG	60	601	Laguna
Riverwash, sandy	RWS	602	602	-
Beach Sand	BCS	118	604	Palawan
Gravel deposits	GRV	149	605	La Union
Braided River Beds	BRB	36	606	Negros Occ
Dune Land	DNL	594	610	Ilocos Norte
Sand Dunes	DNL	594	610	Cagayan
Gullied Land	GDL	611	611	-
Landslides	LSL	613	613	-
Lava Flows	LVF	614	614	-
Volcanic Rockland	VRL	-	614	Rizal
Quarry	QRY	27	615	Bataan
Escarpment	EPT	-	616	Laguna
River Terrace Escarpment	RTE	-	617	Laguna
Canyons and Gorges	CGS	35	618	Negros Occ
Mine Tailing Pond	MTP	37	619	Negros Occ
Rock Land	RKL	599	622	Cagayan
Rock Outcrop	RKO	623	623	-
Rough Broken land	RBK	326	624	Bukidnon
Rough Mountain Land	RMT	202	625	Palawan
Rubble Land	RBL	366	626	Agusan
Limestone RockLand	LMR	581	627	Zamboanga N

Miscellaneous Land Types	Letter Code	Old No. Code	New No. Code*	Origin
Stony Land	STL	629	628	-
Rough Stony Land	RSL	171	629	Abra
Swamps	SWP	630	630	-
Tidal swamps, clayey	SWP1	-	630a	Bulacan
Tidal swamps, loamy	SWP2		630b	Bulacan
Tidal swamps, mucky	SWP3		630c	Bulacan
Marshes	MRS	-	630	-
Wet spots, ponds	WSP	-	630	Laguna
Filled-up soils	FIL	29	631	Rizal
Hydrosols	HYD	1	632	-
Sand and coral bed	SCB	595	633	Ilocos Norte
Mt. Soils Undiff.	MTS	45	645	-
Mountainous Land	MTL	-	646	-
Bog, deep	BOG	593	647	Cagayan; Lanao
Soils, undifferentiated	Specify series	-	648	-
Bodies of water	WB	-	675	-
Rivers, streams	WB	-	675	-
Water reservoir/Dam	WR	-	676	-
Unclassified Islands	UCI	-	680	-
Unsurveyed Areas	USV	-	681	-
Built-up /Urban Areas	BA	-	690	-

Note: Miscellaneous land types are used in soil classification and mapping for areas of land that have little or no natural soil or that are too nearly inaccessible for orderly examination, or where, for other reasons, it is not feasible to classify the soil. A miscellaneous land type may be part of a complex that includes one or more other miscellaneous land types or part of a complex that has one or more soil types in it.

SOIL TYPES

Soil types refer to different sizes of mineral particles in a particular soil series. In old provincial soil maps, map legends are based on soil series types, e.g. Alaminos loam—103; Alaminos loam, degraded phase—104; Alaminos sandy loam—105; Alaminos soils, undiffentiated—106; Alaminos clay loam—407; Alaminos silty clay loam— 699; Alaminos clay—166. Since we are fixing soil series code to a singular number, soil types are given separate codes. In digitizing the old soil maps, Alaminos is given 06 as new number code (page 31) ; hence, Alaminos loam is 06L; Alaminos sandy loam is 06SL; Alaminos soils, undifferentiated is 06*SLU* (page 42). If Alaminos is the only soil series undifferentiated in the soil map, use the legend for [Alaminos] *Soils Undifferentiated—647;* if there are other soil series undifferentiated in the soil map, it is not advisable to use number code 647 to avoid confusion. Alaminos clay loam is 06CL; Alaminos silty clay loam is 06SiCL; and Alaminos clay is 06C. Please refer to Soil Phases Legend for Alaminos loam, degraded phase.

Soil Type	**Code**
Very Coarse Sand	VCoS
Coarse Sand	CoS
Sand	S
Fine Sand	FS
Very Fine Sand	VFS
Loamy Coarse Sand	LCoS
Loamy Sand	LS
Loamy Fine Sand	LFS
Loamy Very Fine Sand	LVFS
Sandy Loam	SL
Fine Sandy Loam	FSL
Very Fine Sandy Loam	VFSL
Loam	L
Silt Loam	SiL
Silt	Si

Soil Type	**Code**
Coarse Sandy Clay Loam	CoSCL
Sandy Clay Loam	SCL
Fine Sandy Clay Loam	FSCL
Clay Loam	CL
Silty Clay Loam	SiCL
Coarse Sandy Clay	CoSC
Sandy Clay	SC
Fine Sandy Clay	FSC
Silty Clay	SiC
Clay	C
Very Fine Clay	VFC
Gravel	G
Gravelly Sandy Loam	GSL
Gravelly Loam	GL
Soils Undifferentiated (647)	*SLU*

SOIL PHASES

A soil phase is a subdivision of soil series. In the soil map, it is a distinct soil mapping unit for which the soil series could be further delineated to improve the soil map utility for agricultural planning. Slope and erosion are most common soil phases used; but these are not the only criteria used by soil surveyors in soil mapping.

Slope

The slope classes used by Soil Survey Division for soil maps are already harmonized with ALMED as early as 1990s when the Soil Information System and the Land Resources Information System were developed under a BSWM-JICA Technical Cooperation. The Soil Survey Division, however retained the slope symbols, A-B-C-D-E-F. The Soil Survey slope symbols are patterned after international practices, specifically that of the USDA Soil Survey Staff, and these symbols are internationally recognized. They cannot just be changed because it is the ALMED practice; or else, the Philippine soil map becomes unreadable to international audience. They are used not just as mapping symbol at soil series level but also at higher levels of soil classification, specifically at the family level. As in the USDA Soil Survey Staff traditional practice, slope symbol follows the soil series name: **BaA** for Philippines is Barang Soil Series, 0-3% slopes while for USA is Bach silt loam, 0-2% slopes; **CbB** for the Philippines is Cabangan Series, 3-8% slopes while for USA is Casco sandy loam, 2-6% slopes. The meaning of soil series legend would change for every country but the slope symbol is fixed to a corresponding slope class. These are international symbols that cannot be changed that easily at BSWM level. Note that soil maps prepared before 1990 have slope classes similar to those of USDA-Soil Survey Staff and digitizers should be aware to make the necessary legend meaning accordingly.

Legend	Description	New Reports	Old Reports
A	Level to nearly level	0-3%	0-2%
B	Nearly level to gently sloping		2-5%
B	Gently sloping to undulating	3-8%	
C	Gently sloping to undulating		5-8%
C	Strongly sloping to rolling	8-18%	
D	Undulating to slightly rolling		8-18%
D	Moderately steep to hilly	18-30%	
E	Slightly rolling to strongly rolling		18-25%
E	Steep	30-50%	
F	Very steep to mountainous	>50%	
F	Strongly rolling to steep		25-40%
G	Steep to very steep hills and mountains		>40%

Either an erosion or a flooding phase

e0	Non-eroded phase
e1	Slightly eroded phase
e2	Moderately eroded phase
e3	Severely eroded phase
f0	Non-flooded phase
f1	Slightly flooded phase
f2	Moderately flooded phase
f3	Severely flooded phase

The term designating the eroded soil phase is the last term in the soil name: *Sampaloc loam, 8-15% slopes, slightly eroded.*

Deposits on the surface

DS1	Overblown phase (deposits of wind-eroded materials on the surface are great enough to influence soil management but not great enough to make significant impact on the characteristics of the soil series).
DS2	Overwash phase (deposits of water-eroded materials on the soil surface are thick enough to influence management but not deep enough to destroy the essential characteristics of the soil series).
DS3	Wind hummocky phase (recent wind-laid deposits form fine pattern of hummocks that markedly alter management requirements of the soil; original soil is still identifiable).

Rock fragments

G0	Non-gravelly phase
G1	Slightly gravelly phase
G2	Gravelly phase
G3	Very gravelly phase
G4	Extremely gravelly phase
Cb	Cobbly phase
St0	Non-stony phase
St1	Stony phase
St2	Very stony phase
St3	Extremely stony phase
Rb	Rubbly phase

Rockiness

R0	Non-rocky phase
R1	Slightly rocky phase
R2	Rocky phase
R3	Very rocky phase

Soil Depth

Soil depth phases are used where variations in depth to a contrasting layer are significant to soil use, management, or behaviour. Normally this depends on the objective of the survey.

D1	Shallow phase
D2	Deep phase
D3	Moderately deep phase
D4	Very deep phase

Substratum

Where the underlying materials contrast with the material above and interpretations are affected, substratum phases are used. The kind of contrasting material is indicated in the name of the map unit.

Ca	Calcareous substratum phase
Ch	Chalk substratum phase

Cl	Clay substratum phase
Gy	Gypsiferous substratum phase
Lc	Lacustrine substratum phase
Ma	Marly substratum phase
Sn	Sandy substratum phase
Si	Silty substratum phase
Sh	Shale substratum phase
Ti	Till substratum phase

Note:

The terms are descriptive and not mutually exclusive, other terms can be used as appropriate. Coordinate with Soil Survey Division for additional legend not listed here. The identifying term follows the name of the taxon and any designation for surface texture and precedes any term for slope or erosion in the phrase name: *Sampaloc silt loam, gravelly substratum, 5 to 8% slopes*. Where there is a choice between using a depth phase or a substratum phase to identify a map unit, a depth phase is generally used if the contrasting layer is bedrock.

Soil-water

Phases are used to distinguish differences in soil-water state, water table level, drainage, and the like where the series range in one of these properties need to be divided for the purpose of the survey.

Wt1	High water table phase
Wt2	Moderately deep water table phase
Wt3	Low water table phase
h1	Well drained phase
h2	Moderately drained phase
h3	Poorly drained phase
h4	Very poorly drained phase
Dr	Drained* phase
Du	Undrained* phase
We0	Dry phase
We1	Slightly wet phase
We2	Moderately wet phase
We3	Wet phase
Po	Ponded phase

*Some soils have properties that reflect former wetness but have been drained artificially; hence “drained” could be separated from “undrained”.

Salinity/Sodicity

Sa0	Non-saline phase
Sa1	Slightly saline phase
Sa2	Moderately saline phase
Sa3	Strongly saline phase
So	Sodic phase

Terms for saline phases follow terms for surface texture: *Sampaloc silt loam, strongly saline phase.* For some soils, recognizing a sodic phase is useful; no degrees of sodicity is required: *Sampaloc silt loam, sodic, 0-3% slopes.*

Physiography

Landforms or physiographic position maybe used as a phase criterion to distinguish phases of a single soil mapping unit. A soil that developed from deposits of Taal Volcano ashes 3 meters thick on a terrace maybe so much like a soil in a similar deposit on a tillplain that the two are members of the same soil series. These may have to be distinguished on the soil map, depending on the purpose of the soil survey.

Be	Bench
Dep	Depressional
Fa	Fan
Ka	Karst
Ri	Ridge
Te	Terrace

The physiographic phase designation follows the term for surface texture and precedes any term for slopes and erosion: *Sampaloc gravelly loam, fan, 0 to 8 percent slopes.*

Thickness.

Thickness phases are used to divide the range of thickness of solum or of the upper of the upper horizons if mappable areas of one such phase differ consistently from areas of the other phase and require different interpretations for the purpose of the survey. Note that phases are not used to differentiate thickness of the subsoil or the substratum.

Su1	Thick surface
Su2	Thin surface
So1	Thick solum
So2	Thin solum

The thickness term follows any terms for surface texture and precedes any terms for slope or erosion: *Sampaloc fine sand, thick surface, 0-3% slopes.*

Climate

In some places, especially in mountains or hilly areas, precipitation or air temperature can differ greatly within short distances, yet these differences may not be reflected in the internal properties of the soil. Where differences of this kind are significant for purposes of the survey and can be identified and mapped consistently, climatic phases are used. Only two climatic conditions are recognized for a soil mapping unit: (1) the common climate that influences the greatest extent of the soil mapping unit, from which the climate designation is omitted; (2) a departure from the common climate for which a climatic designation is used. The departure maybe either of two directions from the norm—

Wa	Warm
Co	Cool
Hp	High precipitation
Lp	Low precipitation

The appropriate term follows texture: *Sampaloc sandy loam, cool.*

Others

A great variety of phase distinctions could be made depending on the purpose of the survey. The phases designated by such special terms are defined to fit special kind of soils. Such phases are defined in reference to the common properties of the soil mapping unit. It would not be surprising that some terms would have specific meanings when used for different soil mapping units and in different survey areas.

Cal	Calcareous phase
Le	Leached surface phase
Drk	Dark surface phase
Dg	Degraded phase
Lw	Lowland phase
Up	Upland phase
St	Steep phase
Adb	Adobe phase
E	Eroded phase
F	Flooded phase
Gu	Gullied phase
Bur	Burned phase (for organic soils)

AREA DISTINCTIONS

For some purposes, attributes of areas need to be shown in names of map units even though these are attributes of land areas rather than attributes of the reference taxa used in naming kinds of soil. Phases are not appropriate for such uses, as they are subdivisions of soil taxa, variants, or kinds of miscellaneous area.

Terms that are not attributes of reference taxa are used to qualify map unit names in terms of limiting features of entire areas. These qualifying terms are perhaps most useful for characterizing features of the areas of soil associations of small scale maps, but they are also used for some units of detailed maps.

Rock outcrop in areas of soil is an example of an attribute of areas. A map unit that is a geographic mixture of soil and rock outcrop is named and defined as a complex if the rock outcrop is more than 10 percent of the area. To distinguish, the qualified unit from phases, the word "area" is used: "Typic Ustropepts, very rocky areas".

Gullied lands can be recognized as "gullied areas". They are used for areas having gullies so deep that intensive measures including reshaping, are required to reclaim the soil.

Climate may also be used to qualify areas. Climatic qualified areas are based on air temperature and precipitation: warm areas, cool areas, high precipitation areas, low precipitation areas. Each of the terms is connotative only in reference to the common atmospheric climate for the soil series and must be described specifically for each map unit to which itare used where temperature or precipitation are markedly different within parts of a single soil resource inventory area.

A great variety of other area distinctions can be made. In addition, we can use frequently flooded area, occasionally flooded area, burned area. The "burned area" can be used for organic soils that have lost enough of their organic materials by fire

that their potential for use or their management requirements have been altered.
is applied. They are used where temperature or precipitation are markedly different within parts of a single soil resource inventory area.

A great variety of other area distinctions can be made. In addition, we can use frequently flooded area, occasionally flooded area, burned area. The "burned area" can be used for organic soils that have lost enough of their organic materials by fire that their potential for use or their management requirements have been altered.

Generally, phase symbols can also be used for area distinctions. A letter "**A**" can be added to the symbol to redirect attention that it is an area distinction, not a soil phase.

LEGEND FOR MAPPING SOILS AT HIGHER LEVELS OF CLASSIFICATION (SOIL TAXONOMY MAPPING)

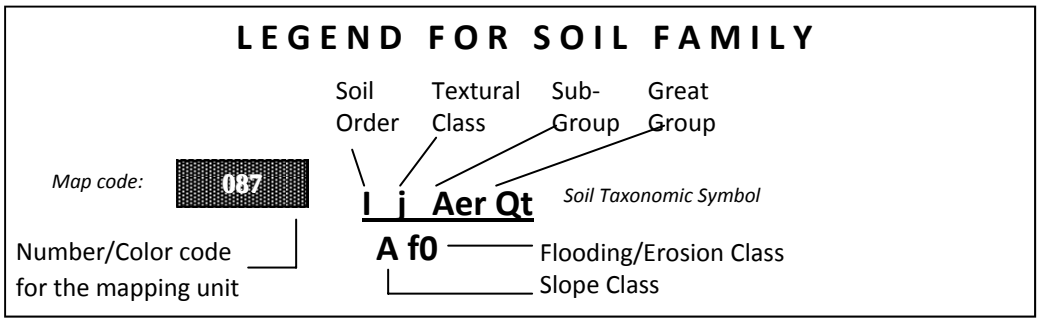
The Philippines adopt the USDA Soil Taxonomy as a system of soil classification. It is a six-hierarchical level of classification: order (dominant processes that developed soil); suborder (control of current soil forming processes); great group (degree of expressions of horizons); subgroup (blending of soil forming processes, intergrades and extragrades; where none, we have the *typic* concept); family (internal features influencing soil-water relations); and series (homogeneity of composition and morphology).

SOIL FAMILY LEVEL:

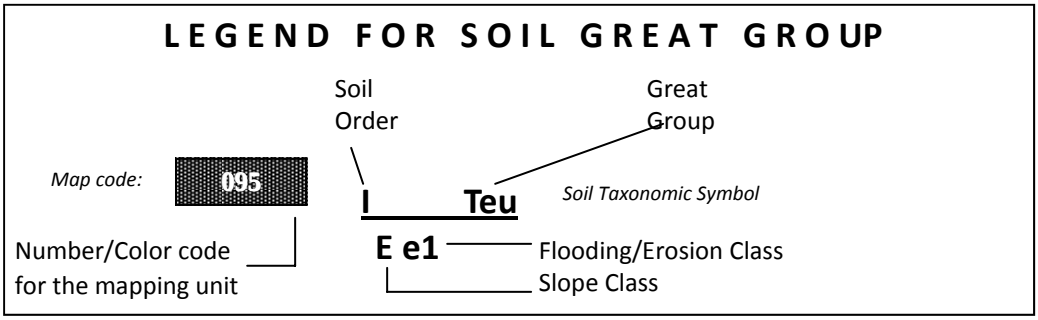
At soil family level, the practice in the Philippines is to name soils based on the following sequence: Broad textural class averaged over control section—Mineralogy class—Soil temperature class—Soil Subgroup—Soil Great Group—Slope—Erosion or Flooding Class. Example: *Very fine, mixed, isohyperthermic, Typic Pellusterts, 3.0—8.0% slope, no apparent erosion.*

Soil mapping unit code: For analog mapping, we leave it to the soil survey staff to assign an Arabic numeral for every mapping project. For digital mapping, the numerical code assignment for the Great Group begins on page 55, to be in harmony with the Soil Information System which is the basis for digital filing of maps. In GIS, there is inter-phase between spatial data and attribute data.

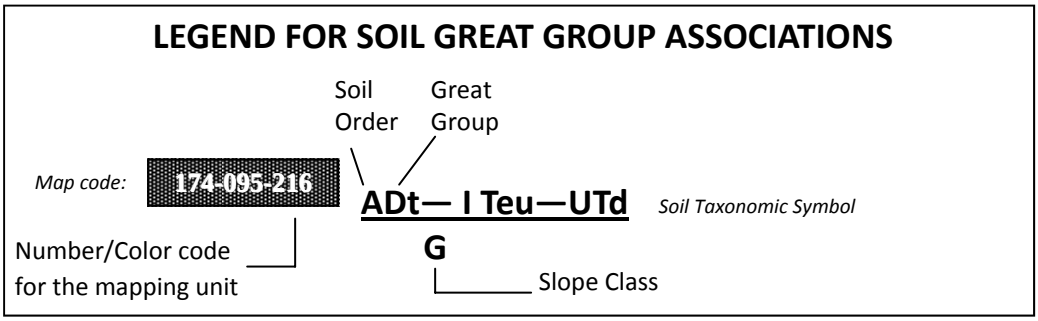
Soil taxonomic symbol: In Soil Taxonomic mapping, symbols are normally presented as a fraction—with the numerator composed of taxonomic class and the denominator the slope and flooding/erosion class. The same principle would hold true for soil mapping at soil classification levels higher than soil family.



The soil family legend example on the previous page is for *Inceptisols, fine clay, mixed, isohyperthermic, Aeric Tropaquepts, 0-2 percent slopes, no apparent flooding.* Note that under current practice, the mineralogy and the soil temperature regime are not included as part of symbol simplification. These two parameters, however, can be included, depending on discussions with soil survey proponents.



The example for legend for Soil Great Group is for *Inceptisols, Eutropepts, 18 -25 percent slopes, slightly eroded.*



The example for legend for Soil Great Group Associations is for *Alfisols, Tropudalfs—Inceptisols, Eutropepts, Ultisols, Tropodults Association, greater than 45 percent slopes.*

STANDARD LEGEND FOR SOIL ORDER

Entisols	E
Inceptisols	I
Andisols	D
Vertisols	V
Mollisols	M
Alfisols	A
Ultisols	U
Oxisols	O
Histosols	H

There are no assigned legend for Aridisols, Gelisols, and Spodosols as these are not found in the Philippines.

STANDARD LEGEND FOR GREAT GROUPS AND ASSOCIATIONS

Soil Taxonomy symbol: Note that in the Soil Great Groups for Soil Taxonomy mapping prepared by Soil Survey Division, the Great Group letter legend is not exclusive for the Soil Order. As we move to another soil order, the letter legend is repeated and the proper reading depends on the Soil Order. It is therefore incumbent to precede any Great Group legend with Order legend to properly read the legend.

Map number code: While the original mainframe Soil Information System (SIS) assigns specific number code per great groups based on 1990 Key to Soil Taxonomy (which was not revised under ARIS, circa 2005), actual soil map code such as the publication of the Soil Taxonomy Map of the Philippines (1994) follows what is stated on page 53—*We leave it to the soil survey staff to assign an Arabic numeral for every mapping project.* We clarify that this is for analog mapping. The number code (SIS code) presented here is compulsory for DIGITAL mapping purposes to be in harmony with the Soil Information System. Please note that there are subsequent editions of Soil Taxonomy and the SIS number code presented here are based on the 2003 and 2006 editions. However, there are Soil Great Groups based on the 1990 Key to Soil Taxonomy no longer existing in 2003/2006 editions and their corresponding number codes are not deleted and merely marked with brackets [ ] because these soil maps are not updated to the current edition of Soil Taxonomy; we only specify the edition year of the Key to Soil Taxonomy when the map was produced. Any changes for SIS codes should be coordinated with Soil Survey Division and with ISRIS.

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Alfisols (A)	Aqualfs (Q)	Duraqualfs	Qd	001
		Fragiaqualfs	Qf	002
		Glossaqualfs	Qs	003
		Kandiaqualfs	Qk	004
		Natraqualfs	Qn	005
		[Ochraqualfs]	Qo	006
		Phlinthaqualfs	Qp	007
		[Umbraqualfs]	Qu	008
		[Tropaqualfs]	Qt	169
		Vermaqualfs	Qv	170
		Albaqualfs	Qa	171
		Epiaqualfs	Qi	172
		Endoaqualfs	Qe	173
	Udalfs (UD)	[Agrudalfs]	UDa	009
		Ferrudalfs	UDfe	010
		Fragiudalfs	UDf	011

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Alfisols (A)	Udalfs (UD)	Fraglodussalfs	UDfl	012
		Glossudalfs	UDs	013
		Hapludalfs	UDh	014
		Kandiudalfs	UDk	015
		Kanhapludalfs	UDkh	016
		Natrudalfs	UDn	017
		Rhodudalfs	UDr	018
		Paleudalfs	UDpe	019
		[Tropudalfs]	UDt	174
	Ustalfs (US)	Durustalfs	USd	020
		Haplustalfs	USh	021
		Kandiustalfs	USk	022
		Kanhaplustalfs	USu	023
		Natrustalfs	USn	024
		Paleustalfs	USpe	025
		Plinthustalfs	USp	026
		Rhodustalfs	USr	027
Andisols (D)	Aquands (Q)	Duraquands	Qd	028
		Haplaquands	Qh	029
		Melanaquands	Qm	030
		Placaquands	Qc	031
		Vitraquands	Qvi	032
		Epiaquands	Qi	175
		Endoaquands	Qe	176
	Udands (UD)	Durudands	UDd	033
		Fulvudands	UDfv	034
		Hapludands	UDh	035
		Hydrudands	UDy	036
		Melanudands	UDm	037
		Placudands	UDc	038
	Ustands (US)	Durustands	USd	039
		Haplustands	USh	040
	Vitrands (VI)	Udivitrands	VIud	041

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Andisols (A)	Vitrands (VI)	Ustivitrands	VIus	042
Entisols (E)	Aquents (Q)	Fluvaquents	Qfv	043
		Haplaquents	Qh	044
		Hydraquents	Qy	045
		Psammaquents	Qx	046
		Sulfaquents	Qb	047
		[Tropaquents]	Qt	048
		Epiaquents	Qi	177
		Endoqaquents	Qe	178
	Arents (K)	Udarents	Kud	049
		Ustarents	Kus	050
		Torriarents	Ktr	179
	Fluvents (R)	[Tropofluvents]	Rt	051
		Udifluvents	Rud	052
		Ustifluvents	Rus	053
		Torrifluvents	Rtr	180
	Orthents (W)	[Troporthents}	Wt	054
		Udorthents	Wud	055
		Ustorthents	Wus	056
		Torriorthents	Wtr	181
	Psamments (X)	Quartzipsamments	Xz	057
		[Tropopsamments]	Xt	058
		Udipsamments	Xud	059
		Ustipsamments	Xus	060
		Torripsamments	Xtr	182
Histosols (H)	Fibrists (F)	[Luvifibrists]	F1	061
		[Medifibrists]	F2	062
		Sphagnofibrists	F3	063
		[Tropofibrists]	Ft	064
		Haplofibrists	Fh	183
	Folists (G)	[Tropopolists]	Gt	065
		Torrifolists	Gtr	184
		Ustifolists	Gus	185

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Histosols (H)	Folists (G)	Udifolists	Gud	186
	Hemists (HE)	Luvihemists	HE1	66
		[Medihemists]	HE2	67
		Sulfihemists	HEb1	68
		Sulfohemists	HEb2	69
		[Tropohemists]	HEt	70
		Haplohemists	HEh	187
	Saprists (I)	[Medisaprists]	I2	071
		[Troposaprists]	It	072
		Sulfisaprists	Ib2	188
		Sulfosaprists	Ib3	189
		Haplosaprists	Ih	190
Inceptisols (I)	[Andepts (A)]	[Durandepts]	Ad	073
		[Strandepts]	Ast	074
		[Eutrandepts]	Aeu	075
		[Hydrandepts]	Ay	076
		[Placandepts]	Ac	077
		[Vitrandepts]	Avi	078
	Aquepts (Q)	[Andaquepts]	Qan	079
		Fragiaquepts	Qf	080
		Halaquepts	Qn3	081
		[Haplaquepts]	Qh	082
		Humaquepts	Qm2	083
		[Placaquepts]	Qc	084
		[Plintaquepts]	Qp	085
		Sulfaquepts	Qb	086
		[Tropaquepts]	Qt	087
		Petraquepts	Qpt	191
		Vermaquepts	Qv	192
		Epiaquepts	Qi	193
		Endoaquepts	Qe	194
	[Ochrepts (O)]	[Durochrepts]	Od	088
		[Dystrochrepts]	Ody	089

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Inceptisols (I)	[Ochrepts (O)]	[Eutrochrepts]	Oeu	090
		[Fragiochrepts]	Of	091
		[Ustochrepts]	Ous	092
	[Plaggepts (G)]	-	Gg	093
	[Tropepts (T)]	[Dystropepts[	Tdy	094
		[Eutropepts[	Teu	095
		[Humitropepts[	Thm2	096
		[Sombitropepts[	Tsm	097
		[Ustropepts]	Tus	098
		[Fragiumbrepts]	Tf	099
		[Haplumbrepts]	Th	100
	Anthrepts (AN)	Plaggenthrepts	ANg	195
		Haplanthrepts	ANh	196
	Ustepts (US)	Durustepts	USd	197
		Calciustepts	USca	198
		Dystrustepts	USdy	199
		Haplustepts	USh	200
	Udepts (UD)	Sulfudepts	UDb	201
		Durudepts	UDd	202
		Fragiudepts	UDf	203
		Eutrudepts	UDeu	204
		Dystrudepts	UDdy	205
Mollisols (M)	Aquolls (Q)	Argiaquolls	Qrg	101
		Calciaquolls	Qca	102
		Duraquolls	Qd	103
		Haplaquolls	Qh	104
		Natraquolls	Qn	105
		Epiaquolls	Qi	206
		Endoaquolls	Qe	207
	Rendolls (RE)	Haprendolls	REh	106
	Udolls (UD)	Argiudolls	UDrg	107
		Hapludolls	UDh	108
		Paleudolls	UDpe	109

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Mollisols (M)	Udolls (UD)	Vermudolls	UDv	110
		Natrudolls	UDn	208
		Calciudolls	UDca	209
	Ustolls (US)	Argiustolls	USrg	111
		Calciustolls	USca	112
		Durustolls	USd	113
		Haplustolls	USh	114
		Natrustolls	USn	115
		Paleustolls	USpe	116
		Vermustolls	USv	117
Oxisols (O)	Aquox (Q)	Acraquox	Qcr	118
		Eutraquox	Qeu	119
		Haplaquox	Qh	120
		Plinthaquox	Qp	121
	Perox (PX)	Acroperox	PXcr	122
		Eutroperox	PXeu	123
		Haploperox	PXh	124
		Kandiperox	PXk	125
		Sombriperox	PXsm	126
	Udox (UD)	Acrudox	UDcr	127
		Eutrodox	UDeu	128
		Hapludox	UDh	129
		Kandiudox	UDk	130
		Sombriudox	UDsm	131
	Ustox (US)	Acrustox	UScr	132
		Eutrustox	USeu	133
		Haplustox	USh	134
		Kandiustox	Uk	135
		Sombriustox	USsm	136
	Torrox (TR)	Acrotorrox	TRcr	210
		Eutrotorrox	TReu	211
		Haplotorrox	TRh	212

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Ultisols (U)	Aquults (Q)	Fragiaquults	Qf	137
		Kandiaquults	Qk	138
		Kanhaplaquults	Qkh	139
		Ochraquults	Qo	140
		Paleaquults	Qpe	141
		Plinthaquults	Qp	142
		Umbraquults	Qum	143
		Epiaquults	Qi	213
		Endoaqults	Qe	214
	Humults (HU)	Haplohumults	HUh	144
		Kandihumults	HUk	145
		Kanhaplohumults	HUkh	146
		Palehumults	HUpe	147
		Plinthohumults	HUp	148
		Sombrihumults	HUsm	149
		[Tropohumults]	HUt	215
	Udults (UD)	Fragiudults	UDf	150
		Hapludults	UDh	151
		Kandiudults	UDk	152
		Kanhapludults	UDkh	153
		Paleudults	UDpe	154
		Plinthudults	UDp	155
		Rhodudults	UDr	156
		[Tropudults]	UDt	216
	Ustults (US)	Haplustults	USh	157
		Kandiustults	USk	158
		Kanhaplustults	USu	159
		Paleustults	USpe	160
		Plinthustults	USp	161
		Rhodustults	USr	162
Vertisols (V)	Aquerts (Q)	Sulfaquerts	Qb	163
		Salaquerts	Qn2	166
		Duraquerts	Qd	217

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Vertisols (V)	Aquerts (Q)	Natraquerts	Qn	218
		Calciaquerts	Qca	219
		Dystraquerts	Qdy	220
		Epiaquerts	Qi	221
		Endoaquerts	Qe	222
	Torrerts (TR)	Salitorrerts	TRn2	223
		Gypsitorrerts	TRgy	224
		Calcitorrerts	TRca	225
		Haplotorrerts	TRh	226
	Usterts (US)	Dystrusterts	USdy	227
		Salusterts	USn2	228
		Gypsiusterts	USgy	229
		Calciusterts	USca	230
		Haplusterts	USh	231
		[Chromusterts]	USch	167
		[Pellusterts]	USpl	168
	Uderts (UD)	Dystruderts	UDdy	232
		Hapluderts	UDh	233
		[Chromuderts]	UDch	164
		[Pelluderts]	UDpl	165

Note on Soil Great Group taxonomic legend notation: The soil taxonomic legend for Soil Great Group should always be preceded by Soil Order for proper reading and interpretation:

A Qd— Duraqualfs
D Qd— Duraquands
M Qd—Duraquolls

A Qi— Epiaqualfs
D Qi— Epiaquands
I Qi— Epiaquepts
MQi—Epiaquolls
U Qi—Epiaquults
V Qi—Epiaquerts

A USd— Durustalfs
I USd— Durustepts
MUSd— Durustolls

STANDARD LEGEND FOR SOIL SUB-GROUP (2006 edition, Soil Taxonomy)

SUBGROUP	LEGEND
Abruptic	Abr
Abruptic Argiduritic	AbA
Acraquoxic	Acr
Acrudoxic	Acu

SUBGROUP	LEGEND
Acrudoxic Thaptic	AcT
Acrustoxic	Acx
Aeric	Aer
Aeric Chromic Vertic	ACV
Aeric Fragic	AeF
Aeric Humic	AeH
Aeric Umbric	AeU
Aeric Vertic	AeV
Albaquic	Alq
Alfic	Alf
Alfic Humic	AfH
Alfic Lithic	AfL
Alfic Vertic	AfV
Alic	Alc
Andic	And
Andic Ombroaquic	AdO
Andic Oxyaquic	AOx
Anionic	Ani
Anionic Aquic	AnA
Anthraquic	Atq
Aquandic	Aqd
Aquertic	Aqr
Aquertic Chromic	AqC
Aquic	Aqi
Aquic Arenic	AqA
Aquic Cumulic	AqC
Aquic Duric	ADu
Aquic Dystric	ADy
Aquic Humic	AHu
Aquic Lithic	ALi
Aquic Pachic	APa
Aquic Petroferric	APe
Aquultic	Aqt

SUBGROUP	LEGEND
Arenic	Are
Arenic Oxyaquic	ArO
Arenic Plinthaquic	ArP
Arenic Plinthic	APh
Arenic Umbric	AUm
Argic	Arg
Argiaquic	Agc
Argidic	Agd
Argiduritic	Ard
Calciargidic	Crg
Calcic	Ccc
Calcic Pachic	CPh
Calcic Udic	CUd
Calcidic	Cld
Chromic	Chr
Chromic Udic	CUd
Chromic Vertic	CVe
Cumulic	Cum
Cumulic Vertic	CmV
Duric	Dur
Duric Histic	DuH
Dystric	Dys
Dystric Fluventic	DFl
Dystric Vitric	DVi
Entic	Ent
Entic Ultic	EUt
Eutric	Euc
Eutric Oxyaquic	EOx
Eutric Pachic	EPa
Fibric	Fib
Fluvaquentic	Flq
Fluvaquentic Vertic	FVe
Fluventic	Fve

SUBGROUP	LEGEND
Fluventic Humic	FHu
Fragiaquic	Fgq
Fragic	Frg
Fragic Oxyaquic	FOx
Glossaquic	Glq
Grossarenic	Gro
Grossarenic Plinthic	GPh
Glossic	Glo
Glossic Vertic	GVe
Gypsic	Gyp
Halic	Hal
Halic Terric	HTe
Haplargidic	Hlg
Haplic	Hpl
Haplocalcidic	Hcd
Haploduridic	Hdr
Hemic	Hem
Histic	His
Humaqueptic	Hmq
Humic	Hum
Humic Inceptic	HIn
Humic Lithic	HuL
Humic Pachic	HPa
Humic Psammentic	HPs
Humic Rhodic	HRh
Humic Xanthic	HXa
Hydraquentic	Hyq
Hydric	Hyd
Hydric Pachic	HPa
Inceptic	Icp
Kandic	Kan
Kandiudalfic	Kdf
Kanhaplic	Khc

SUBGROUP	LEGEND
Lamellic	Lam
Lamellic Ustic	LUs
Leptic	Lep
Leptic Torrertic	LTo
Leptic Vertic	LVe
Limnic	Lim
Lithic	Lit
Lithic Petrocalcic	LPe
Lithic Ultic	LUl
Lithic Ustic	LUs
Mollic	Mol
Natric	Nat
Ombroaquic	Obq
Oxic	Oxc
Oxyaquic	Oxq
Oxyaquic Vertic	OVe
Pachic	Pac
Pachic Udertic	PUd
Pachic Ultic	PUl
Pachic Vertic	PVe
Pachic Vitric	PVi
Placic	Plc
Petrocalcic	Pec
Petrofferic	Pef
Plinthaquic	Plq
Plinthic	Plc
Psammentic	Psm
Rendollic	Ren
Rhodic	Rho
Ruptic-Lithic	RLi
Ruptic Ultic	RUl
Salidic	Sal
Sphagnic	Sph

SUBGROUP	LEGEND
Sulfaqueptic	Sfq
Sulfic	Sfc
Sodic	Sod
Terric	Ter
Thaptic	Tha
Thapto-Histic	THis
Torrertic	Torr
Torrifluventic	Trf
Torriorthentic	Tro
Torripsammentic	Trp
Torroxic	Tor
Typic	Typ
Udandic	Uda
Udertic	Ude
Udic	Udi
Udifluventic	Udf
Udollic	Udo
Udorthentic	Udr
Ultic	Ult
Ustic	Ust
Ustertic	Utt
Ustollic	Usl
Umbric	Umb
Vermic	Vem
Vertic	Vet
Vitrandic	Vdc
Vitric	Vtc
Vitritorrandic	Vtr
Xanthic	Xan

Note: *Soil maps based on older versions of Key to Soil Taxonomy and without corresponding subgroup code should be referred to the Soil Survey Division for code assignment.*

STANDARD LEGEND FOR PARTICLE SIZE CLASSES

For Soil Taxonomy Maps produced 2003 and earlier based on 1990 Key to Soil Taxonomy

Fragmental	a
Sandy skeletal	b
Loamy skeletal	c
Clayey skeletal	d
Sandy	e
Coarse loamy	f
Fine loamy	g
Coarse silty	h
Fine silty	i
Fine clay	j
Very fine clay	k
Contrasting particle-size classes	
Fine loamy over sandy	r
Fine loamy over coarse loamy	l
Coarse loamy over sandy	m
Clayey over fragmental	n
Fine silty over sandy	o
Clayey over sandy	p
Coarse loamy over sandy	s
Sandy over clayey	t

For digitization of currently produced Soil Taxonomy Maps based on 2003/2006 editions of Key to Soil Taxonomy

Pumiceous	pp
Cindery	cc
Fragmental	a
Ashy-pumiceous	ap
Ashy-skeletal	ak
Ashy	aa
Medial-pumiceous	mp
Medial-skeletal	mk
Medial	mm
Hydrous-pumiceous	hp
Hydrous-skeletal	hk
Hydrous	hy
Sandy-skeletal	b
Loamy-skeletal	c
Clayey-skeletal	d
Sandy	e
Loamy	lo

Coarse-loamy	f
Fine-loamy	g
Coarse-silty	h
Fine-silty	i
Clayey	cl
Fine	j
Very fine	k

Contrasting particle sizes:

Ashy over clayey	aacl
Ashy over clayey-skeletal	aad
Ashy over loamy-skeletal	aac
Ashy over loamy	aalo
Ashy over medial-skeletal	aamk
Ashy over medial	aamm
Ashy over pumiceous or cindery	aapp *or* aacc
Ashy over sandy or sandy-skeletal	aae *or* aab
Ashy skeletal over fragmental or cindery	aka *or* akcc
Ashy skeletal over loamy-skeletal	akc
Cindery over loamy	cclo
Cindery over medial-skeletal	ccmk
Cindery over medial	ccmm
Clayey over fragmental	n
Clayey over loamy	cllo
Clayey over loamy-skeletal	clc
Clayey over sandy or sandy-skeletal	p
Clayey skeletal over sandy or sandy skeletal	de *or* db
Coarse loamy over clayey	fcl
Coarse loamy over fragmental	fn
Coarse loamy over sandy or sandy-skeletal	m
Coarse silty over clayey	hcl
Coarse silty over sandy or sandy-skeletal	s
Fine loamy over clayey	gcl
Fine loamy over fragmental	ga
Fine loamy over sandy or sandy-skeletal	r
Fine silty over clayey	icl
Fine silty over fragmental	ia
Hydrous over clayey skeletal	hyd
Hydrous over clayey	hycl
Hydrous over fragmental	hya
Hydrous over loamy-skeletal	hyc
Hydrous over loamy	hylo
Hydrous over sandy or sandy-skeletal	hye *or* hyb
Loamy over ashy or ashy pumiceous	loaa *or* loap
Loamy over sandy or sandy-skeletal	loe *or* lob
Loamy over pumiceous or cindery	lopp *or* locc

Loamy-skeletal over cindery	ccc
Loamy-skeletal over clayey	ccl
Loamy-skeletal over fragmental	ca
Loamy-skeletal over sandy or sandy-skeletal	ce *or* cb
Medial over ashy	mmaa
Medial over ashy-pumiceous or ashy-skeletal	mmap *or* mmak
Medial over clayey-skeletal	mmd
Medial over clayey	mmcl
Medial over fragmental	mma
Medial over hydrous	mmhy
Medial over loamy-skeletal	mmc
Medial over loamy	mmlo
Medial over pumiceous or cindery	mmpp or mmcc
Medial over sandy or sandy-skeletal	mme or mmb
Medial-skeletal over fragmental or cindery	mka or mkcc
Medial skeletal over loamy-skeletal	mkd
Pumiceous or ashy-pumiceous over loamy	pplo or aplo
Pumiceous or ashy-pumiceous over medial-skeletal	ppmk or apmk
Pumiceous or ashy-pumiceous over medial	ppm or appm
Pumiceous or ashy-pumiceous over sandy or sandy skeletal	ppe or appb
Sandy over clayey	ecl
Sandy over loamy	elo
Sandy skeletal over loamy	blo

STANDARD LEGEND FOR MINERALOGY CLASSES

Ferritic	Fe
Gibbsitic	Gi
Sesquic	Se
Ferruginous	Fu
Allitic	Al
Kaolinitic	Ka
Halloysitic	Ha
Mixed	Mx
Amorphic	Am
Ferrihydritic	Fy
Glassy	Gl
Gypsic	Gy
Carbonatic	Ca
Magnesic	Mg
Parasesquic	Ps
Glauconitic	Gc
Smectitic	Sm
Illitic	Il
Vermiculitic	Ve

Isotic	Is
Micaceous	Mi
Paramicaceous	Pm
Siliceous	Si

STANDARD LEGEND FOR CATION EXCHANGE ACTIVITY CLASSES

(Note: Not currently used for soil family classification in the Philippines. Please refer to the 2003/2006 edition of the Key to Soil Taxonomy when CEC classes must be included in the soil family mapping.)

Superactive	CEC1
Active	CEC2
Semiactive	CEC3
Subactive	CEC4

STANDARD LEGEND FOR CALCAREOUS AND REACTION CLASSES

Allic	r4
Calcareous	r3
Acid	r1
Non-acid	r2

STANDARD LEGEND FOR SOIL TEMPERATURE CLASSES

Thermic	T
Hyperthermic	H
Isothermic	IT
Isophyperthermic	IH

OTHER LEGENDS USED FOR SOIL FAMILY MAPPING

***For soil depth classes*.** For soil families in Lithic subgroups and those with fragipan:

Shallow	d2

For sand coatings. For soil families in Quartzipsamments:

Coated	ct1
Uncoated	ct0

For permanent cracks. For Hydraquents that consolidate or shrink after drainage and become Fluvaquents or Humaquepts.

Cracked	V

STANDARD LEGEND FOR FAMILY LEVEL MAPPING OF HISTOSOLS (ORGANIC SOILS)

Particle Size Classes. These are used only for the family names of Terric subgroups of Histosols and Histels. The classes are determined from the properties of the mineral

soil materials in the control section through the use of key to particle size classes. The classes are more generalized than those for soils in other orders.

Fragmental	a
Sandy or sandy skeletal	b
Loamy skeletal	c
Clayey skeletal	d
Clayey	cl
Loamy	lo

Mineralogy classes. There are different kinds of mineralogy classes recognized for families in certain great groups and subgroups of Histosols. The first is the ferrihumic materials, and the second is three types of limnic materials—coprogenous earth, diatomaceous earth, and marl. The third is of Terric subgroups. Refer to the 2006 Key to Soil Taxonomy for definitions and criteria.

Ferrihumic	Feh
Coprogenous	Cog
Diatomaceous	Dia
Marly	Mar

Other Histels and Histosols in Terric subgroups - please use mineralogy classes for mineral soils (page 70).

Reaction classes. Reaction classes are used in all families of Histosols and Histels. Two classes are recognized; please refer to the Key to Soil Taxonomy for definitions:

Eulic	Eu
Dysic	Dy

Soil Temperature classes. The same as for mineral soils (page 71).

Soil Depth classes. Soil depth classes refer to the depth to a root-limiting layer, a fragmental particle-size class, or a cindery or pumiceous substitute class. The root-limiting layers are duripans, petrocalcic, petrogypsic, and placic horizons; continuous ortstein, and densic, lithic, paralithic, and petroferric contacts. Please refer to the Key to Soil Taxonomy for the key to soil depth classes. The shallow class is not used in the suborder Folists.

Micro	Mic
Shallow	Sha

Manual on Map Standards & Symbols for GIS. Addendum: Standard Codes for Soil Taxonomy Maps Based on 2010 Edition of the Keys to Soil Taxonomy. Soil Survey Division. Bureau of Soils and Water Management (3): 73—100, 2009

Addendum:

Standard Codes for Soil Taxonomy Maps

Based on Eleventh (2010) Edition of Keys to Soil Taxonomy

Soil Survey Division Staff
Bureau of Soils and Water Management
Elliptical Road, Diliman, Quezon City
February, 2010

The Philippines adopts the USDA Soil Taxonomy system of classification. While generally many nations have their distinct soil classification system, soil scientists from many countries around the world have contributed significantly to the development of Soil Taxonomy ever since the publication some 35 years ago of *Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys.* The Philippine adoption is significant because of the collaborative link with the international soil science community. This means not only savings in terms of basic soil survey researches for which we do not have the funds, but enables our soil survey outputs to adhere to international standards and to be linked with the global soil map. Despite many efforts to downgrade the role of Soil Survey Division these past many years, soil resources inventory remains a critical first step for any development planning. Soil map is an important output of BSWM.

The release of the Eleventh (2010) Edition of the Keys to Soil Taxonomy even before this manual goes to press puts the final manuscript behind the fast paced international developments in soil survey. The editors decided to come up with an addendum as it would take time for an updated edition of this manual to be released. It might be another four years, in time for the 2014 Seoul World Soil Congress, when the twelfth edition of the Keys to Soil Taxonomy is expected to be published.

As this is only an addendum, please refer to the previous chapter for digitization of soil taxonomy maps based on earlier editions of the Keys to Soil Taxonomy. We are, however, consolidating the standard legend; and therefore, will include in this addendum still active soil taxonomy nomenclature for which a legend is hereby reiterated, and for the new soil taxa, a new legend is assigned.

STANDARD LEGEND FOR SOIL ORDER

Entisols	E
Inceptisols	I
Andisols	D

Vertisols	V
Mollisols	M
Alfisols	A
Ultisols	U
Oxisols	O
Histosols	H

There are no assigned legend for Aridisols, Gelisols, and Spodosols as these are not found in the Philippines.

STANDARD LEGEND FOR SUBORDER AND GREAT GROUPS

Soil Taxonomy symbol: Note that in the Soil Great Groups for Soil Taxonomy mapping prepared by Soil Survey Division, the Great Group letter legend is not exclusive for the Soil Order. As we move to another soil order, the letter legend is repeated and the proper reading depends on the Soil Order. It is therefore incumbent to precede any Great Group legend with Order legend to properly read the legend.

Map number code: Only soil taxa actively used in the 2010 edition of Soil Taxonomy are included in this addendum. Please refer to the previous chapter for legend of soil taxonomy mapping units used in earlier editions. Any changes for SIS codes should be coordinated with Soil Survey Division and with ISRIS.

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Alfisols (A)	Aqualfs (Q)	Phlinthaqualfs	Qp	007
		Duraqualfs	Qd	001
		Natraqualfs	Qn	005
		Fragiaqualfs	Qf	002
		Kandiaqualfs	Qk	004
		Vermaqualfs	Qv	170
		Glossaqualfs	Qs	003
		Epiaqualfs	Qi	172
		Endoaqualfs	Qe	173
	Udalfs (UD)	Natrudalfs	UDn	017
		Ferrudalfs	UDfe	010
		Fraglodussalfs	UDfl	012
		Fragiudalfs	UDf	011
		Kandiudalfs	UDk	015
		Kanhapludalfs	UDkh	016

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Alfisols (A)	Udalfs (UD)	Paleudalfs	UDpe	019
		Rhodudalfs	UDr	018
		Glossudalfs	UDs	013
		Hapludalfs	UDh	014
	Ustalfs (US)	Durustalfs	USd	020
		Plinthustalfs	USp	026
		Natrustalfs	USn	024
		Kandiustalfs	USk	022
		Kanhaplustalfs	USkh	023
		Paleustalfs	USpe	025
		Rhodustalfs	USr	027
		Haplustalfs	USh	021
Andisols (D)	Aquands (Q)	Placaquands	Qc	031
		Duraquands	Qd	028
		Vitraquands	Qvi	032
		Melanaquands	Qm	030
		Haplaquands	Qh	029
		Epiaquands	Qi	175
		Endoaquands	Qe	176
	Torrands (TR)	Duritorrands	TRd	234
		Vitritorrands	TRvi	235
		Haplotorrands	TRh	236
	Udands (UD)	Placudands	UDc	038
		Durudands	UDd	033
		Melanudands	UDm	037
		Hydrudands	UDy	036
		Fulvudands	UDfv	034
		Hapludands	UDh	035
	Ustands (US)	Durustands	USd	039
		Haplustands	USh	040
	Vitrands (VI)	Udivitrands	VIud	041
		Ustivitrands	VIus	042

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Entisols (E)	Wassents (J)	Frasiwassents	Jfr	237
		Psammowassents	Jx	238
		Sulfiwassents	Jb1	239
		Fluviwassents	Jfv	240
		Haplowassents	Jh	241
	Aquents (Q)	Sulfaquents	Qb	047
		Hydraquents	Qy	045
		Psammaquents	Qx	046
		Fluvaquents	Qfv	043
		Epiaquents	Qi	177
		Endoqaquents	Qe	178
	Arents (K)	Udarents	Kud	049
		Ustarents	Kus	050
		Torriarents	Ktr	179
	Fluvents (FV)	Udifluvents	FVud	052
		Ustifluvents	FVus	053
		Torrifluvents	FVtr	180
	Orthents (W)	Udorthents	Wud	055
		Ustorthents	Wus	056
		Torriorthents	Wtr	181
	Psamments (X)	Quartzipsamments	Xz	057
		Udipsamments	Xud	059
		Ustipsamments	Xus	060
		Torripsamments	Xtr	182
Histosols (H)	Fibrists (F)	Sphagnofibrists	F3	063
		Haplofibrists	Fh	183
	Folists (G)	Torrifolists	Gtr	184
		Ustifolists	Gus	185
		Udifolists	Gud	186
	Hemists (HE)	Sulfohemists	HEb2	69
		Sulfihemists	HEb1	68
		Luvihemists	HE1	66
		Haplohemists	HEh	187

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Histosols (H)	Saprists (I)	Sulfosaprists	Ib3	189
		Sulfisaprists	Ib2	188
		Haplosaprists	Ih	190
	Wassists (J)	Frasiwassists	Jfr	242
		Sulfiwassists	Jb1	243
		Haplowassists	Jh	244
Inceptisols (I)	Aquepts (Q)	Sulfaquepts	Qb	086
		Petraquepts	Qpt	191
		Halaquepts	Qn3	081
		Fragiaquepts	Qf	080
		Vermaquepts	Qv	192
		Humaquepts	Qm2	083
		Epiaquepts	Qi	193
		Endoaquepts	Qe	194
	Anthrepts (AN)	Plaggenthrepts	ANg	195
		Haplanthrepts	ANh	196
	Udepts (UD)	Sulfudepts	UDb	201
		Durudepts	UDd	202
		Fragiudepts	UDf	203
		Humudepts	UDhu	245
		Eutrudepts	UDeu	204
		Dystrudepts	UDdy	205
	Ustepts (US)	Durustepts	USd	197
		Calciustepts	USca	198
		Humustepts	UShu	246
		Dystrustepts	USdy	199
		Haplustepts	USh	200
Mollisols (M)	Aquolls (Q)	Duraquolls	Qd	103
		Natraquolls	Qn	105
		Calciaquolls	Qca	102
		Argiaquolls	Qrg	101
		Epiaquolls	Qi	206
		Endoaquolls	Qe	207

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Mollisols (M)	Rendolls (RE)	Haprendolls	REh	106
	Udolls (UD)	Natrudolls	UDn	208
		Calciudolls	UDca	209
		Paleudolls	UDpe	109
		Argiudolls	UDrg	107
		Vermudolls	UDv	110
		Hapludolls	UDh	108
	Ustolls (US)	Durustolls	USd	113
		Natrustolls	USn	115
		Calciustolls	USca	112
		Paleustolls	USpe	116
		Argiustolls	USrg	111
		Vermustolls	USv	117
		Haplustolls	USh	114
Oxisols (O)	Aquox (Q)	Acraquox	Qcr	118
		Plinthaquox	Qp	121
		Eutraquox	Qeu	119
		Haplaquox	Qh	120
	Torrox (TR)	Acrotorrox	TRcr	210
		Eutrotorrox	TReu	211
		Haplotorrox	TRh	212
	Ustox (US)	Sombriustox	USsm	136
		Acrustox	UScr	132
		Eutrustox	USeu	133
		Kandiustox	Uk	135
		Haplustox	USh	134
	Perox (PX)	Sombriperox	PXsm	126
		Acroperox	PXcr	122
		Eutroperox	PXeu	123
		Kandiperox	PXk	125
		Haploperox	PXh	124

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Oxisols (O)	Udox (UD)	Sombriudox	UDsm	131
		Acrudox	UDcr	127
		Eutrodox	UDeu	128
		Kandiudox	UDk	130
		Hapludox	UDh	129
Ultisols (U)	Aquults (Q)	Plinthaquults	Qp	142
		Fragiaquults	Qf	137
		Kandiaquults	Qk	138
		Kanhaplaquults	Qkh	139
		Paleaquults	Qpe	141
		Umbraquults	Qum	143
		Epiaquults	Qi	213
		Endoaqults	Qe	214
	Humults (HU)	Sombrihumults	HUsm	149
		Plinthohumults	HUp	148
		Kandihumults	HUk	145
		Kanhaplohumults	HUkh	146
		Palehumults	HUpe	147
		Haplohumults	HUh	144
	Udults (UD)	Plinthudults	UDp	155
		Fragiudults	UDf	150
		Kandiudults	UDk	152
		Kanhapludults	UDkh	153
		Paleudults	UDpe	154
		Rhodudults	UDr	156
		Hapludults	UDh	151
	Ustults (US)	Plinthustults	USp	161
		Kandiustults	USk	158
		Kanhaplustults	USu	159
		Paleustults	USpe	160
		Rhodustults	USr	162
		Haplustults	USh	157

ORDER	SUBORDER	GREAT GROUPS	SYMBOL	SIS CODE
Vertisols (V)	Aquerts (Q)	Sulfaquerts	Qb	163
		Salaquerts	Qn2	166
		Duraquerts	Qd	217
		Natraquerts	Qn	218
		Calciaquerts	Qca	219
		Dystraquerts	Qdy	220
		Epiaquerts	Qi	221
		Endoaquerts	Qe	222
	Torrerts (TR)	Salitorrerts	TRn2	223
		Gypsitorrerts	TRgy	224
		Calcitorrerts	TRca	225
		Haplotorrerts	TRh	226
	Usterts (US)	Dystrusterts	USdy	227
		Salusterts	USn2	228
		Gypsiusterts	USgy	229
		Calciusterts	USca	230
		Haplusterts	USh	231
	Uderts (UD)	Dystruderts	UDdy	232
		Hapluderts	UDh	233

Note on Soil Great Group taxonomic legend notation: The soil taxonomic legend for Soil Great Group should always be preceded by Soil Order for proper reading and interpretation:

A Qd— Duraqualfs
D Qd— Duraquands
M Qd—Duraquolls

A Qi— Epiaqualfs
D Qi— Epiaquands
I Qi— Epiaquepts
MQi—Epiaquolls
U Qi—Epiaquults
V Qi—Epiaquerts

A USd— Durustalfs
I USd— Durustepts
MUSd— Durustolls

STANDARD LEGEND FOR SOIL SUB-GROUP (2010 Edition, Keys to Soil Taxonomy)

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Abruptic	Abr	Argiaquolls, Argiudolls
Acraquoxic	Acr	Duraquands, Melanaquands
		Kandiaquults
Acrudoxic	Acu	Durudands, Fulvudands, Hapludands, Hydrudands, Melanudands, Placudands
		Kandiudults, Kanhapludults

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Acrudoxic Hydric	AcH	Hapludands, Melanudands
Acrudoxic Plinthic	AcP	Kandiudults
Acrodoxic Thaptic	AcT	Hapludands, Hydrudands
Acrudoxic Ultic	AcU	Hapludands
Acrudoxic Vitric	AcU	Melanudands
Acrustoxic	Acx	Kandiustults, Kanhaplustults
Aeric	Aer	Endoaqualfs, Epiaqualfs, Fragiaqualfs, Glossaqualfs, Kandiaqualfs
		Endoaquents, Epiaquents, Fluvaquents Haplowassents, Psammowassents, Sulfiwassents
		Endoaquepts, Epiaquepts, Fragiaquepts, Halaquepts, Humaquepts
		Calciaquolls
		Acraquox, Eutraquox, Haplaquox, Plinthaquox
		Endoaquults, Epiaquults, Fragiaquults, Kandiaquults, Paleaquults
		Calciaquerts, Duraquerts, Dystraquerts, Endoaquerts, Epiaquerts
Aeric Chromic Vertic	ACV	Epiaqualfs
Aeric Fragic	AeF	Endoaqualfs, Epiaqualfs, Glossaqualfs
		Epiaquults
Aeric Vertic	AeV	Epiaqualfs
Aeric Umbric	AeU	Kanhaplaquults
Alfic	Alf	Hapludands, Haplustands, Udivitrands
		Udarents
		Argiudolls, Argiustolls
Alfic Lithic	AfL	Argiustolls
Alfic Vertic	AfV	Argiudolls
Alic	Alc	Endoaquands, Epiaquands, Hapludands
Andic	And	Fragiudalfs, Fraglossudalfs, Glossudalfs, Hapludalfs, Paleudalfs
		Udifluvents

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Andic	And	Duridepts, Dystrudepts, Eutrudepts, Humudepts, Dystrustepts, Haplustepts, Humustepts
		Argiudolls, Hapludolls, Argiustolls, Haplustolls
		Haploperox, Kandiperox, Hapludox, Kandiudox
		Haplohumults, Kandihumults, Kanhaplohumults, Palehumults, Kandiudults, Kandiustults, Kanhaplustults
Andic Ombroaquic	AdO	Kandihumults
Andic Oxyaquic	AOx	Dystrudepts, Humudepts
Anionic	Ani	Acrudox, Acrustox
Anionic Aquic	AnA	Acrudox, Acrustox
Anthraquic	Atq	Hapludalfs, Paleudalfs
		Hapludands, Melanudands
		Ustifluvents, Ustorthents
		Eutrudepts, Haplustepts
		Haplustolls
		Paleudults
Anthropic	Atp	Kandihumults, Kanhaplohumults
Aquandic	Aqd	Endoaqualfs, Epiaqualfs, Glossudalfs
		Fluvaquents
		Endoaquepts, Epiaquepts, Halaquepts, Humaquepts, Durudepts, Dystrudepts, Humudepts
		Endoaquolls, Epiaquolls
		Kanhaplaquults, Haplohumults, Palehumults, Kandiudults
Aqueptic	Aqp	Haplustox
Aquertic	Aqr	Glossudalfs, Hapludalfs, Haplustalfs, Natrustalfs, Paleustalfs
		Udifluvents, Ustifluvents
		Eutrudepts
		Argiudolls, Hapludolls, Argiustolls, Haplustolls
Aquertic Chromic	AqC	Hapludalfs

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Aquollic	Aql	Hapludalfs
Aquodic	Aqo	Quartzpsamments
Aquic	Aqi	Fragiudalfs, Fraglossudalfs, Glossudalfs, Hapludalfs, Kandiudalfs, Kanpaludalfs, Natrudalfs, Paleudalfs, Haplustalfs, Kandiustalfs, Kanhaplustalfs, Natrustalfs, Paleustalfs, Haplustands, Udivitrands, Ustivitrands
		Vitritorrands, Durudands, Fulvudands, Hapludands, Hydrudands, Melanudands, Placudands, Durustands
		Torrifluvents, Udifluvents, Ustifluvents, Torriorthents, Udorthents, Ustorthents, Quartzipssaments, Udipsamments, Ustipssaments
		Durudepts, Dystrudepts, Fragiudepts, Humudepts, Calciustepts, Dystrustepts, Haplustepts
		Argiudolls, Calciudolls. Argiustolls, Calciustolls, Haplustolls, Natrustolls, Paleustolls, Vermustolls
		Acroperox, Eutroperox, Haploperox, Kandiperox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
		Haplohumults, Kandihumults, Kanhaplohumults, Palehumults, Fragiudults Hapludults, Kandiudults, Paleudults, Haplustults, Kandiustults, Kanhaplustults
		Salitorrerts, Dystruderts, Hapluderts, Dystrusterts, Salusterts
Aquic Arenic	AqA	Glossudalfs, Hapludalfs, Haplustalfs, Kandiustalfs, Natrustalfs, Paleustalfs
		Hapludults, Paleudults
Aquic Cumulic	AqC	Hapludolls, Haplustolls
Aquic Duric	AqD	Hapludands
Aquic Humic	AqH	Dystrudepts
Aquic Lithic	AqL	Acroperox, Eutroperox, Haploperox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Aquic Pachic	APa	Argiudolls, Hapludolls, Paleudolls
Aquic Petrofferic	APe	Acroperox, Haploperox, Kandiperox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
Aquic Arenic	AqA	Kandiudults, Paleudults
Aquultic	Aqt	Hapludalfs, Haplustalfs
Arenic	Are	Endoaqualfs, Epiqualfs, Glossaqualfs, Kandiaqualfs, Glossudalfs, Kandiudalfs, Paleudalfs, Haplustalfs, Kandiustalfs, Natrustalfs, Paleustalfs
		Eutrudepts
		Argiaquolls, Argiudolls
		Endoaquults, Epiaquults, Kandiaquults, Paleaquults, Fragiudults, Hapludults, Kanhapludults, Paleudults, Haplustults, Kandiustults, Kanhaplustults
Arenic Oxyaquic	ArO	Glossudalfs, Hapludalfs
Arenic Plinthic	ArPh	Kandiudalfs, Paleudalfs
		Kandiaquults, Paleaquults, Kandiudults, Kanhapludults, Paleudults, Kandiustults
Arenic Plinthaquic	ArP	Kandiudults, Paleudults
Arenic Rhodic	ArR	Kandiudults, Paleudults
Arenic Umbric	Aum	Endoaqualfs, Epiaqualfs Kaniaqualfs
		Kandiaquults, Paleaquults
Argic	Arg	Duraquolls
Argiduridic	Ard	Durustolls
Calcic	Ccc	Haplustalfs
		Haplottorrands, Vitritorrands, Haplustands, Ustivitrands
		Haplustepts
		Argiudolls, Hapludolls, Natrudolls, Paleudolls, Paleustolls
		Haplusterts
Calcic Udic	CUd	Haplustalfs

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Calcidic	Cld	Haplustalfs, Paleustalfs
		Argiustolls, Paelustolls
Chromic	Chr	Duraquerts, Dystraquerts, Endoaquerts, Epiaquerts, Salaquerts, Calcitorrerts, Gypsitorrerts, Haplotorrerts, Salitorrerts, Dystruderts, Hapluderts, Calciusterts, Dystrusterts,Gypsiusterts, Haplusterts, Salusterts
Chromic Udic	CUd	Haplusterts
Chromic Vertic	CVe	Endoaqualfs, Epiaqualfs, Hapludalfs
Cumulic	Cum	Humaquepts, Humudepts
		Endoaquolls, Epiaquolls, Hapludolls, Haplustolls
Cumulic Vertic	CmV	Endoaquolls, Epiaquolls
Duric	Dur	Endoaquands, Epiaquands, Vitraquands, Haplotorrands, Vitritorrands, Hapludands
		Torrifluvents, Torriorthents
		Halaquepts
		Endoaquolls, Epiaquolls, Argiustolls, Haplustolls, Natrustolls
Duric Histic	DuH	Placaquands
Durinodic	Dun	Ustorthents
Dystric	Dys	Haplustands
		Eutrudepts, Haplustepts
Dystric Vitric	DVi	Haplustands
Entic	Ent	Humudepts
		Durudands, Fulvudands, Hapludands, Hydrudands, Melanudands
		Haprendolls, Hapludolls, Durustolls, Haplustolls, Paleustolls, Vermustolls
		Dystraquerts, Endoaquerts, Epiaquerts, Salaquerts, Calcitorrerts, Haplotorrerts, Salitorrerts, Dystruderts, Hapluderts, Calciusterts, Dystrusterts, Gypsiusterts, Haplusterts, Salusterts
Entic Udic	EUd	Haplusterts

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Eutric	Euc	Humudepts
		Acrudox, Acrustox
Eutric Lithic	EuL	Fulvudands
Eutric Pachic	EPa	Fulvudands
Eutric Thaptic	EuT	Hapludands
Fibric	Fib	Haplohemists, Frasiwassists, Haplowassists, Sulfiwassists
Fluvaquentic	Flq	Haplofibrists, Sphagnofibrists, Haplohemists
		Endoaquepts, Epiaquepts, Humaquepts, Dystrudepts, Eutrudepts, Humudepts
		Endoaquolls, Epiaquolls, Hapludolls, Haplustolls
Fluvaquentic Vertic	FVe	Endoaquolls, Epiaquolls
Fluventic	Fve	Frassiwassents, Psammowassents, Sulfiwassents, Haplosaprists
		Endoaquepts, Dystrudepts, Humudepts, Dystrustepts, Haplustepts
		Calciudolls, Hapludolls, Haplustolls
Fluventic Humic	FHu	Dystrudepts
Fraqiaquic	Fgq	Glossudalfs, Hapludalfs, Paleudalfs
		Dystrudepts, Eutrudepts
		Hapludults, Paleudults
Fragic	Frg	Endoaqualfs, Epiaqualfs, Glossaqualfs, Glossudalfs, Hapludalfs, Paleudalfs
		Endoaquepts, Epiaquepts, Dystrudepts, Fragiudepts,
		Epiaquults, Hapludults, Kanhapludults, Paledudults
Fragic Oxyaquic	FOx	Hapludalfs
Glossaquic	Glq	Hapludalfs, Natrudalfs, Paleudalfs
		Fragiudults
Glossic	Glo	Natraqualfs, Paleudalfs
		Natraquolls, Natrudolls, Natrustolls
		Fragiudults
Glossic Vertic	GVe	Natrudolls, Natrustolls

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Grossarenic	Gro	Endoaqualfs, Epiaqualfs, Kandiaqualfs, Kandiudalfs, Paleustalfs
		Argiaquolls
		Endoaquults, Epiaquults, Kandiaquults, Paleaquults Hapludults, Kandiudults, Paleudults
Grossarenjc Plinthic	GPh	Kandiudalfs, Paleudalfs, Kandiustalfs
		Kandiudults, Paleudults
Grossic	Grs	Hydrowassents
Gypsic	Gyp	Calciustepts, Haplustepts
		Calciustolls
		Haplusterts
Halic	Hal	Haplosaprists
		Endoaquerts, Epiaquerts, Haplotorrerts, Calciusterts, Gypsiusterts, Haplusterts
Halic Terric	HTe	Haplosaprists
Haplargidic	Hlg	Natrustalfs
Haplic	Hpl	Glossudalfs
		Sulfaquents, Udarents, Ustarents, Sulfiwassents
		Vermudolls, Durustolls
		Plinthustults
Haplocalcidic	Hcd	Haplustepts
Haploduridic	Hdr	Torripsamments
		Durustolls
Hemic	Hem	Haplofibrists, Sphagnofibrists, Haplosaprists
Histic	His	Glossaqualfs
		Duraquands, Endoaquands, Epiaquands, Vitraquands
		Sulfaquents
		Humaquepts
		Endoaquolls, Eipaquolls
		Eutraquox, Haplaquox
Histic Placic	HPl	Petraquepts
Humaqueptic	Hmq	Endoaquents, Epiaquents, Fluvaquents, Psammaquents

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Humic	Hum	Fragiaqualfs
		Durustands, Haplustands, Udivitrands, Ustivitrands
		Endoaquepts, Epiaquepts, Fragiaquepts, Dystrudepts, Eutrudepts, Fragiudepts, Dystrustepts
		Eutraquox, Haplaquox, Acroperox, Eutroperox, Kandiperox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
		Fragiudults, Hapludults
Humic Inceptic	HIn	Eutroperox, Eutrudox, Eutrustox
Humic Lithic	HuL	Dystrudepts, Eutrudepts
Humic Psammentic		Dystrudepts
Humic Rhodic	HPs	Acroperox, Eutroperox, Kandiperox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
Hydraquentic	Hyq	Humaquepts, Sulfaquepts
Hydric	Hyd	Endoaquands, Epiaquands, Melanaquands, Durudands, Fulvudands, Hapludands, Melanudands, Placudands
		Frasiwassents
		Haplofibrists, Sphagnofibrists, Haplohemists
Hydric Thaptic	HyT	Hapludands
Hydric Pachic	HPa	Melanaquands
Inceptic	Icp	Hapaludalfs, Haplustalfs
		Haprendolls
		Eutroperox, Eutrudox, Hapludox, Eutrustox, Haplustox
		Hapludults
Kandic	Kan	Paleustalfs
		Plinthaquults
Kandiudalfic	Kdf	Eutroperox, Eutrudox
Kandiustalfic	Kuf	Eutrustox
Kanhaplic	Khc	Haplustalfs, Rhodustalfs
		Haplustults

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Lamellic	Lam	Hapludalfs, Paleudalfs, Haplustalfs, Paleustalfs
		Quartzipssaments, Udipsamments, Ustipssaments
		Dystrudepts, Haplustepts
		Argiudolls
		Hapludults, Paleudults
Lamellic Ustic	LuS	Quartzipssaments
Leptic	Lep	Natrustalfs
		Natrudolls, Natrustolls
		Dystraquerts, Endoaquerts, Epiaquerts, Salaquerts, Calcitorrerts, Haplotorrerts, Salitorrerts, Dystruderts, Hapluderts, Calciusterts, Dystrusterts, Gysiusterts, Salusterts
Leptic-Torrertic	LTo	Natrustalfs
		Natrustolls
Leptic Udic	LUd	Haplusterts
Leptic Vertic	LVe	Natrudolls, Natrustolls
Limnic	Lim	Haplofibrists, Sphagnofibrists, Haplohemists
Lithic	Lit	Hapludalfs, Kanhapludalfs, Haplustalfs, Kanhaplustalfs, Rhodustalfs
		Endoaquands, Melanaquands, Placaquands Vitraquands, Haplotorrands, Vitritorrands, Fulvudands, Hapludands, Hydrudands, Melanudands, Placudands, Haplustands, Udivitrands, Ustivitrands
		Endoaquents, Psammaquents, Torriorthents, Udorthents, Ustorthents, Quartzipssaments Torripsamments, Udipsamments, Ustipsamments, Frasiwassents, Haplowassents, Hydrowassents, Psammowassents, Sulfiwassents
		Haplofibrists, Sphagnofibrists, Torrifolists, Udifolists, Ustifolists, Haplohemists, Haplosaprists
		Endoaquepts, Dystrudepts, Eutrudepts, Humudepts Calciustepts, Dystrustepts, Haplustepts, Humustepts
		Endoaquolls, Haprendolls, Argiudolls, Calciudolls, Hapludolls, Vermudolls, Argiustolls, Calciustolls, Haplustolls, Vermustolls

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Lithic	Lit	Acroperox, Eutroperox, Haploperox, Acrotorrox, Eutrotorrox, Haplotorrox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
		Haplohumults, Kanhaplohumults, Hapludults, Rhodudults, Haplustults, Kanhaplustults, Rhodulstults
		Hapluderts, Calciusterts, Dystrusterts, Gypsiusterts Haplusterts, Salusterts
Lithic Petrocalcic	LPe	Calciustepts
		Calciustolls
Lithic—Ruptic—Entic	LRE	Hapludults
Lithic Ustic	LUs	Torriorthents
Mollic	Mol	Endoaqualfs, Epiaqualfs, Glossaqualfs, Natraqualfs, Hapludalfs, Kandiudalfs, Paleudalfs, Natrustalfs
		Endoaquents, Epiaquents, Fluvaquents, Psammaquents, Udarents, Udifluvents, Ustifluvents
		Endoaquepts, Epiaquepts
Mollic Oxyaquic	MOq	Hapludalfs
Natric	Nat	Vermaqualfs
		Duraquolls, Durustolls
Ombroaquic	Obq	Kandihumults, Kanhaplohumults, Kandiudults, Haplustults, Kanhaplustults
Oxic	Oxc	Hapludands, Haplustands
		Dystrudepts, Humudepts, Dystrustepts, Haplustepts, Humustepts
		Argiudolls, Haplustolls
Oxyaquic	Oxq	Fragiudalfs, Fraglossudalfs, Glossudalfs, Hapludalfs, Kandiudalfs, Kanhapludalfs, Paleudalfs, Haplustalfs, Paleustalfs
		Fulvudands, Hapludands, Udivitrands
		Torrifluvents, Udifluvents, Ustifluvents, Torriorthents, Udorthents, Ustorthents, Quartzipssaments, Torripsamments, Udipsamments, Ustipssaments
		Dystrudepts, Humudepts, Haplustepts, Humustepts

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Oxyaquic	Oxq	Argiudolls, Hapludolls, Paleudolls, Argiustolls, Calciustolls, Haplustolls
		Haplustox
		Haplohumults, Palehumults, Hapludults, Paleudults
		Dystruderts, Hapluderts
Oxyaquic Vertic	OVe	Glossudalfs, Hapludalfs, Haplustalfs, Paleustalfs
		Argiudolls
Pachic	Pac	Melanaquands, Durudands, Fulvudands, Haplustands
		Humudepts
		Argiudolls, Paleudolls, Argiustolls, Calciustolls, Haplustolls, Paleustolls, Vermustolls
Pachic Udertic	PUd	Argiustolls, Haplustolls
Pachic Vertic	PVe	Argiudolls, Hapludolls, Argiustolls, Haplustolls
Pachic Vitric	PVi	Melanudands
Petrocalcic	Pec	Natrustalfs, Paleustalfs
		Duritorrands
		Calciustepts
		Calciaquolls, Natrudolls, Paleudolls, Calciustolls, Paleustolls
		Calcitorrerts, Calciusterts, Haplusterts
Petroferric	Pef	Acroperox, Eutroperox, Haploperox, Kandiperox, Acrotorrox, Eutrotorrox, Haplotorrox, Acrudox, Eutrudox, Hapludox Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
		Haplustults
Plagganthreptic	Pgt	Udipssaments
Plinthaquic	Plq	Kandiudalfs, Paleudalfs
		Eutroperox, Haploperox, Eutrudox, Hapludox, Kandiudox, Eutrustox, Haplustox, Kandiustox
		Fragiudults, Kandiudults, Kanhapludults, Paleudults

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Plinthic	Plc	Fragiaqualfs, Kandiaqualfs, Kandiudalfs, Paleudalfs, Kandiustalfs, Paleustalfs
		Quartzipssaments
		Petraquepts
		Acraquox, Eutraquox, Haplaquox, Acroperox, Eutroperox, Haploperox Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
		Fragiaquults, Kandiaquults, Kanhaplaquults Paleaquults, Umbraquults, Haplohumults, Kandihumults, Palehumults, Fragiudults, Kandiudults, Kanhapludults, Paleudults, Haplustults, Kandiustults, Kanhaplustults
Psammentic	Pss	Hapludalfs, Paleudalfs, Haplustalfs, Paleustalfs
		Frasiwassents
		Humudepts
		Argiudolls
		Hapludults, Paleudults, Rhodudults, Rhodustults
Rendollic	Ren	Eutrudepts
Rhodic	Rho	Kandiudalfs, Kanhapludalfs, Paleudalfs, Kandiustalfs, Kanhaplustalfs, Paleustalfs
		Torripsamments, Ustipsamments
		Aroperox, Haploperox, Kandiperox, Acrudox, Eutrudox, Hapludox, Kandiudox, Acrustox, Eutrustox, Haplustox, Kandiustox
		Kanhapludults, Paleudults, Kandiustults, Kanhaplustults
Ruptic-Alfic	RAf	Dystrudepts, Eutrudepts
Ruptic-Lithic	RuL	Haplustolls
Ruptic-Utlic	RUl	Dystrudepts
Salic	Sac	Sulfaquerts
Salidic	Sal	Natrustalfs
		Sulfaquepts
		Calciustolls, Haplustolls
Sapric	Sap	Haplohemists, Frasiwassists, Haplowassists, Sulfiwassists

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Sodic	Sod	Endoaquents, Hydraquents, Psammaquents
		Vermaquepts
		Endoaquerts, Epiaquerts, Haplotorrerts, Calciusterts, Gypsiusterts, Haplusterts, Salusterts
Sulfaqueptic	Sfq	Dystraquerts
Sulfic	Sfc	Endoaquents, Fluvaquents, Hydraquents, Fluviwassents, Haplowassents, Hydrowassents, Psammowassents, Haplowassists
		Endoaquepts
		Sulfaquerts
Terric	Ter	Haplofibrists, Sphagnofibrists, Haplohemists, Sulfihemists, Haplosaprists, Sulfisaprists
Thaptic	Tha	Duraquands, Endoaquands, Epiaquands, Melanaquands, Placaquands, Vitraquands, Fulvudands, Hapludands, Melanudands, Durustands, Haplustands, Udivitrands, Ustivitrands
Thapto—Histic	THis	Fluvaquents, Hydraquents, Sulfaquents, Frasiwassents, Hydrowassents, Sulfiwas-sents
		Endoaquolls, Epiaquolls
Torrertic	Torr	Haplustalfs, Natrusalfs
		Ustifluvents, Ustorthents
		Calciustepts, Dystrustepts, Haplustepts
		Argiustolls, Calciustolls, Haplustolls, Natrustolls, Paleustolls
Torrifluventic	Trf	Haplustepts
		Haplustolls
Torriorthentic	Tro	Haplustolls
Torroxic	Tor	Haplustolls
Typic	Typ	(all Great Groups)
Udandic	Uda	Kandiustults, Kanhaplustults
Udertic	Ude	Haplustalfs, Paleustalfs
		Haplustepts

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Udertic	Ude	Argiustolls, Calciustolls, Haplustolls, Paleustolls
Udic	Udi	Haplustalfs, Kandiustalfs, Kanhaplustalfs, Paleustalfs, Rhodustalfs
		Ustifluvents
		Calciustepts, Haplustepts
		Argiustolls, Calciustolls, Haplustolls, Paleustolls
		Kandiustults, Kanhaplustults
		Calciusterts, Dystrusterts, Gypsiusterts Haplusterts
Udifluventic	Udf	Haplustepts
Udollic	Udo	Endoaqualfs, Epiaqualfs
Udorthentic	Udr	Haplustolls
Udoxic	Udx	Quartzipssaments
Ultic	Ult	Hapludalfs, Haplustalfs, Paleustalfs
		Fulvudands, Hapludands, Hydrudands, Melanudands, Haplustands, Udivitrands
		Udarents
Umbric	Umb	Endoaqualfs, Epiaqualfs, Kandiaqualfs
		Fragiaquults, Kandiaquults, Paleaquults
Ustandic	Usd	Kandihumults, Kanhaplohumults
Ustertic	Utt	Torrifluvents, Torriorthents
Ustic	Ust	Torrifluvents, Torriorthents, Ustothents, Quartzipssaments, Torripsamments
		Haplohumults, Kandihumults, Kanhaplohumults, Palehumults
		Duraquerts, Dystraquerts, Endoaquerts, Epiaquerts, Salaquerts
Ustoxic	Usx	Quartzipssaments
Vermic	Vem	Fragiaqualfs, Natraqualfs
		Udorthents, Ustorthents
		Hapludolls
Vertic	Vet	Endoaqualfs, Epiaqualfs, Natraqualfs Glossudalfs, Hapludalfs, Natrudalfs, Paleudalfs, Haplustalfs, Natrustalfs, Paleustalfs

SUBGROUP	LEGEND	GREAT GROUPS APPLICABLE TO USE
Vertic	Vet	Fluvaquents, Torrifluvents, Udifluvents, Ustifluvents, Torriorthents, Ustorthents
		Endoaquepts, Epiaquepts, Halaquepts, Dystrudepts, Eutrudepts, Humudepts, Calciustepts, Dystrustepts, Haplustepts
		Duraquolls, Endoaquolls, Epiaquolls, Natraquolls, Haprendolls, Argiudolls, Calciudolls, Hapludolls, Natrudolls, Paleudolls. Argiustolls, Calciustolls, Haplustolls, Natrustolls, Paleustolls
		Epiaquults, Paleuaquults, Hapludults, Paleudults
Vitrandic	Vdc	Fragiudalfs, Fraglossudalfs, Glossudalfs, Halpludalfs, Paleudalfs, Haplustalfs
		Torrifluvents, Udifluvents, Torriorthents, Udorthents, Ustorthents, Toripsamments
		Durudepts, Dystrudepts, Eutrudepts, Fragiudepts, Humudepts, Dystrustepts, Haplustepts, Humustepts
		Argiaquolls, Argiudolls, Hapludolls, Argiustolls, Haplustolls
Vitric	Vtc	Duritorrands, Hapludands, Melanudands, Haplustands
Vitritorrandic	Vtr	Ustorthents
		Argiustolls, Haplustolls

STANDARD LEGEND FOR PARTICLE SIZE CLASSES

Additional particle size classes for family differentiae in 2010 Keys to Soil Taxonomy are in italics. Particle size classes no longer listed are enclosed by brackets.

Pumiceous	pp
Cindery	cc
Fragmental	a
Ashy-pumiceous	ap
Ashy-skeletal	ak
Ashy	aa
Medial-pumiceous	mp
Medial-skeletal	mk
Medial	mm
Hydrous-pumiceous	hp

Hydrous-skeletal	hk
Hydrous	hy
Gypseous—skeletal	gs
Coarse-gypseous	cg
Fine-gypseous	fg
Sandy-skeletal	b
Loamy-skeletal	c
Clayey-skeletal	d
Sandy	e
Loamy	lo
Coarse-loamy	f
Fine-loamy	g
Coarse-silty	h
Fine-silty	i
Clayey	cl
Fine	j
Very fine	k

Contrasting particle sizes:

Ashy over clayey	aacl
Ashy over clayey-skeletal	aad
Ashy over loamy-skeletal	aac
Ashy over loamy	aalo
Ashy over loamy-skeletal	aaloc
Ashy over medial	aamm
Ashy over medial-skeletal	aamk
Ashy over pumiceous or cindery	aapp *or* aacc
Ashy over sandy or sandy-skeletal	aae *or* aab
Ashy skeletal over clayey	akcl
Ashy skeletal over fragmental or cindery	aka *or* akcc
Ashy skeletal over loamy-skeletal	akc
Ashy skeletal over sandy or sandy skeletal	ake or akb
Cindery over loamy	cclo
Cindery over medial-skeletal	ccmk
Cindery over medial	ccmm
Cindery over medial-skeletal	ccmmk
Clayey over coarse-gypseous	clcg
Clayey over fine-gypseous	clfg
Clayey over fragmental	n
Clayey over gypseous-skeletal	clgk
Clayey over loamy	cllo
Clayey over loamy-skeletal	clc
Clayey over sandy or sandy-skeletal	p
Clayey skeletal over sandy or sandy skeletal	de *or* db
Coarse loamy over clayey	fcl

Coarse loamy over fragmental	fn
Coarse loamy over sandy or sandy-skeletal	m
Coarse silty over clayey	hcl
Coarse silty over sandy or sandy-skeletal	s
Fine loamy over clayey	gcl
Fine loamy over fragmental	ga
Fine loamy over sandy or sandy-skeletal	r
Fine silty over clayey	icl
Fine silty over fragmental	ia
Fine silty over sandy or sandy skeletal	ie or ib
Hydrous over clayey skeletal	hyd
Hydrous over clayey	hycl
Hydrous over fragmental	hya
Hydrous over loamy-skeletal	hyc
Hydrous over loamy	hylo
Hydrous over sandy or sandy-skeletal	hye *or* hyb
Loamy over ashy or ashy pumiceous	loaa *or* loap
Loamy over coarse-gypseous	locg
Loamy over fine-gypseous	lofg
Loamy over pumiceous or cindery	lopp *or* locc
Loamy over sandy or sandy-skeletal	loe or lob
Loamy-skeletal over cindery	ccc
Loamy-skeletal over clayey	ccl
Loamy-skeletal over fragmental	ca
Loamy-skeletal over sandy or sandy-skeletal	ce *or* cb
Loamy-skeletal over gypseous-skeletal	lokgk
Medial over ashy	mmaa
Medial over ashy-pumiceous or ashy-skeletal	mmap *or* mmak
Medial over clayey-skeletal	mmd
Medial over clayey	mmcl
Medial over fragmental	mma
Medial over hydrous	mmhy
Medial over loamy-skeletal	mmc
Medial over loamy	mmlo
Medial over pumiceous or cindery	mmpp or mmcc
Medial over sandy or sandy-skeletal	mme or mmb
Medial-skeletal over fragmental or cindery	mka or mkcc
Medial skeletal over loamy-skeletal	mkd
Medial-skeletal over sandy or sandy-skeletal	mke or mkb
Pumiceous or ashy-pumiceous over loamy	pplo or aplo
Pumiceous or ashy pumiceous over loamy skeletal	pplok or aplok
Pumiceous or ashy-pumiceous over medial	ppm or apm
Pumiceous or ashy-pumiceous over medial-skeletal	ppmk or apmk
Pumiceous or ashy-pumiceous over sandy or sandy skeletal	ppe or appb
Sandy over clayey	ecl

Sandy over loamy	elo
Sandy skeletal over loamy	blo

STANDARD LEGEND FOR MINERALOGY CLASSES

Ferritic	Fe
Gibbsitic	Gi
Sesquic	Se
Ferruginous	Fu
Allitic	Al
Kaolinitic	Ka
Halloysitic	Ha
Mixed	Mx
Hypergypsic	Hg
Amorphic	Am
Ferrihydritic	Fy
Glassy	Gl
Gypsic	Gy
Carbonatic	Ca
Magnesic	Mg
Parasesquic	Ps
Glauconitic	Gc
Smectitic	Sm
Illitic	Il
Vermiculitic	Ve
Isotic	Is
Micaceous	Mi
[Paramicaceous	Pm]
Siliceous	

STANDARD LEGEND FOR CATION EXCHANGE ACTIVITY CLASSES

(Note: Not currently used for soil family classification in the Philippines. Please refer to the 2010 edition of the Key to Soil Taxonomy when CEC classes must be included in the soil family mapping.)

Superactive	CEC1
Active	CEC2
Semiactive	CEC3
Subactive	CEC4

STANDARD LEGEND FOR CALCAREOUS AND REACTION CLASSES

Allic	r4
Calcareous	r3
Acid	r1
Non-acid	r2

STANDARD LEGEND FOR SOIL TEMPERATURE CLASSES

Thermic	T
Hyperthermic	H
Isothermic	IT
Isophyperthermic	IH

OTHER LEGENDS USED FOR SOIL FAMILY MAPPING

***For soil depth classes*.** For soil families in Lithic subgroups and those with fragipan:

Shallow	d2

For sand coatings. For soil families in Quartzipsamments:

Coated	ct1
Uncoated	ct0

For permanent cracks. For Hydraquents that consolidate or shrink after drainage and become Fluvaquents or Humaquepts.

Cracked	V

STANDARD LEGEND FOR FAMILY LEVEL MAPPING OF HISTOSOLS (ORGANIC SOILS)

Particle Size Classes. These are used only for the family names of Terric subgroups of Histosols and Histels. The classes are determined from the properties of the mineral soil materials in the control section through the use of key to particle size classes. The classes are more generalized than those for soils in other orders.

Fragmental	a
Sandy or sandy skeletal	b
Loamy skeletal	c
Clayey skeletal	d
Clayey	cl
Loamy	lo

Mineralogy classes. There are different kinds of mineralogy classes recognized for families in certain great groups and subgroups of Histosols. The first is the ferrihumic materials, and the second is three types of limnic materials—coprogenous earth, diatomaceous earth, and marl. The third is of Terric subgroups. Refer to the 2006 Key to Soil Taxonomy for definitions and criteria.

Ferrihumic	Feh
Coprogenous	Cog
Diatomaceous	Dia
Marly	Mar

Other Histels and Histosols in Terric subgroups - please use mineralogy classes for mineral soils (page 95).

Reaction classes. Reaction classes are used in all families of Histosols and Histels. Two classes are recognized; please refer to the Key to Soil Taxonomy for definitions:

Eulic	Eu
Dysic	Dy

Soil Temperature classes. The same as for mineral soils (page 99).

Soil Depth classes. Soil depth classes refer to the depth to a root-limiting layer, a fragmental particle-size class, or a cindery or pumiceous substitute class. The root-limiting layers are duripans, petrocalcic, petrogypsic, and placic horizons; continuous ortstein, and densic, lithic, paralithic, and petroferric contacts. Please refer to the Key to Soil Taxonomy for the key to soil depth classes. The shallow class is not used in the suborder Folists.

Micro	Mic
Shallow	Sha

Manual on Map Standards & Symbols for GIS. Colors for Thematic Mapping. Integrated Soil Resources Information System. Bureau of Soils and Water Management (3): 101—104, 2009

Colors for Thematic Mapping

Integrated Soil Resources Information System
Bureau of Soils and Water Management
Elliptical Road, Diliman, Quezon City

In analog cartography, standard color is set for various mapping units—geomorphological, land management, land use/ vegetation, slope, elevation, erosion, crop zones, land limitations, NPAAD, SAFDZ, etc. Maps use colors to represent data values. The Cartographic Operations Division has a manual that assign color codes to the various mapping units.

Moving into digital cartography, assigning color to mapping units is automatically done by GIS software. The map compositor has to access the **Legend Editor** to assign a color symbol to each of the features in the theme by pointing to the symbol and double clicking. ArcView or ArcGIS will display a palette from which the map compositor can choose colors, styles, border widths, and other display parameters.

Assigning colors to map units of discrete data

While we do not prescribe specific color assignment for the various mapping units BSWM produced, there are universally understood standard colors for physical maps. Physical maps commonly use color most dramatically to show changes in elevation. A palette of greens is often used to display common elevations. Dark green usually represents low-lying land with lighter shades of green used for higher elevations. In the higher elevations, physical maps will often use a palette of light brown to dark brown to show higher elevations. Such maps will commonly use reds or white or purples to represent the highest elevations on the map.

With such a map that uses shades of greens, browns, and the like, it is very important to remember that the color does not represent the ground cover. For example, just because a desert is shown in green due to the low elevation, it doesn't mean that the desert is lush with green crops. Likewise, the peaks of mountains shown in white does not indicate that the mountains are capped in ice and snow all year long.

On physical maps, blues are used for water, with darker blues used for the deepest water and lighter blues used for more shallow water. For elevations below sea level, a green-grey or red or blue-grey or some other color is used.

Road maps and other general use maps are often a jumble of color. They use map colors in a variety of ways:

- Blue - lakes, rivers, streams, oceans, reservoirs, highways, local borders
- Red - major highways, roads, urban areas, airports, special interest sites, military sites, place names, buildings, borders
- Yellow - built-up or urban areas
- Green - parks, golf courses, reservations, forest, orchards, highways
- Brown - deserts, historical sites, national parks, military reservations or bases, contour (elevation) lines
- Black - roads, railroads, highways, bridges, place names, buildings, borders
- Purple - highways, (also used on U.S.G.S. topographic maps to represent features added to the map since the original survey)

As you can see, different maps can use colors in a variety of ways. It is important to look at the map key or map legend for the map you are using to become familiar with the color scheme.

The purpose of map coloring is to color a map so that regions sharing a common border have different colors. The chromatic number is the minimum number of colors necessary to color a map so that regions that have a common border have different colors. Over time, many algorithms have been created for the purpose of map coloring. Some were created upon mathematical proofs; some heuristic in nature, others make use of random assignment. A planar graph is traditionally used where none of the links between nodes intersect one another.

Some of the basic principles used in determining chromatic number are as follows:

(1) Brook's Theorem states that *if v is the largest degree (or valence) of any vertex in a connected graph, G, and G is not a complete graph nor a circuit of odd length, then the chromatic number of G is less than or equal to v.*

(2) In 5-color algorithm, any node with less than 5 neighbours can be easily colored due to the fact that its at most 4 neighbours could not possibly be using all the colors available. Therefore, there is at least one unused color that node N could be filled with. There is unfortunately, no one algorithm in map coloring that can determine, given a planar graph, the maximum colors needed to optimally color it. However, there are algorithms that can get closer.

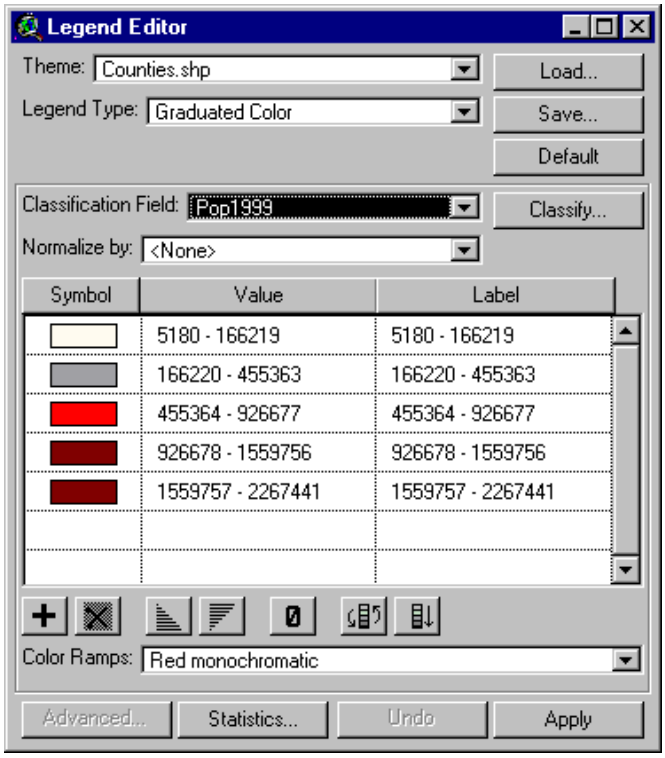
Assigning map colors to map units of continuous data

Special maps called choropleth maps use map color to represent statistical data or continuous data. The color schemes used by choropleth maps is different from general maps in that the color represents data for a given area. Typically, a choropleth map will color each mapping unit based on the data for that area.

Choropleth maps can also be used to show population, educational attain-

ment, ethnicity, density, life expectancy, prevalence of a certain disease, and so much more. When mapping certain percentages, cartographers who design choropleth map will often use different shades of the same color, which produces a very nice visual effect. For example, a map of county-by-county per capita income could use a range of green from light green for lowest per-capita income to dark green for highest per-capita income.

In GIS, one can play with the data values (called fields) in the attribute table from which a corresponding color coded spatial data (choropleth map) is produced. Playing with the attribute table data is not done in analog cartography because of the time consumed in calculations. It is just a breeze in GIS. Normally, the first field is the default and this prompts ArcView to automatically produce a colourful thematic map in which each color indicates a difference in value. The legend editor has a selection box *"Normalize by:"* which allows the map compositor to divide the values in the selected classification field by the values in the field specified by *"Normalize by:"*. By default, ArcView breaks the features into five groups based on the natural breaks by statistical method. The map compositor can change the number of categories and the type of statistical classification by clicking on the *"Classify . . . "* button. The map compositor can choose "Equal Area", "Equal Interval", "Natural Breaks", "Quantile", and "Standard Deviation".



Opening the *"Color Ramps:"* menu bar, lets the map compositor to choose a different set of colors than the default "Red monochromatic" ramp colors. If none of the color ramps are suitable, the map compositor can change each color individually by double-clicking on the corresponding symbol. This will bring up a color and style pallete.

Of particular significance in some situations is the button marked with a  This button allows the map compositor to specify how to display null or dummy values as well as avoid using these values in statistical calculations. In many instances, cells for which data are not available are marked with a specific dummy value.

The map compositor can also round off numbers and change the way each grouping is labelled in the map legend (into something like Low, Medium, High).

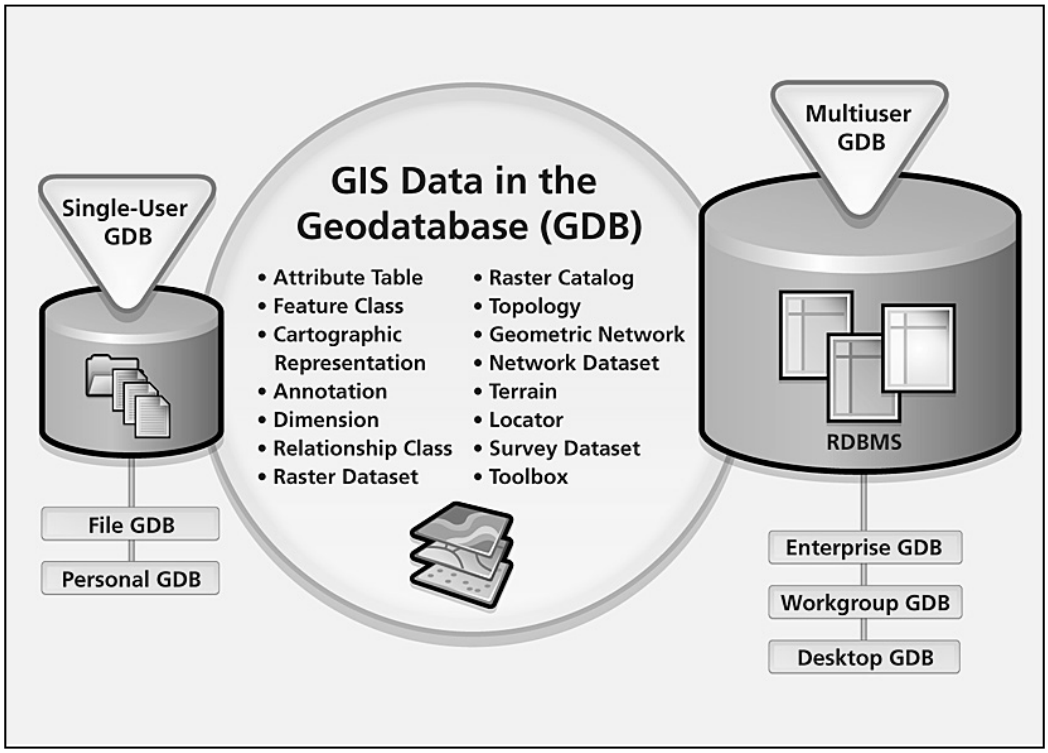
To be able to color maps in ArcView or ArcGIS, it is evident that the map compositor needs to work with the attribute table. Since the map outputs could be as many as there are fields in the attribute table, ISRIS staff have decided to dispense with assigning color codes and leaves it to the map compositor or to the project team members to decide on color assignments of mapping units.

Spatial Data File Management

Integrated Soil Resources Information System
Bureau of Soils and Water Management
Elliptical Road, Diliman, Quezon City

The geodatabase (GDB) is the common data storage and management framework for ArcGIS. This is a container for spatial and attribute data. BSWM GIS data is stored in a central location and in a uniform format for easy access and management. ArcGIS has a comprehensive suite of data conversion tools to easily migrate existing data into the geodatabase. The GDB is more extendable data model compared to shapefiles and coverages. While these shapefiles and coverages are outstanding GIS data storage formats and the most familiar to BSWM staff working on GIS data, they do not take advantage of the latest data storage technologies. The geodatabase is not just another spatial data format that can be used by ArcGIS users, it is considered an integral part of the whole spatial data infrastructure system.

The figure below is extracted from the ESRI website (http://www.esri.com/news/arcnews/winter0809articles/the-geodatabase.html) showing how GDB stores in a central location and in a uniform format BSWM GIS data for easy access and management.



The vector data is stored as thematic layers called feature classes. A feature class is a collection of geographic features with the same geometry type such as point, line, or polygon; the same attributes; and the same coordinate system. Feature classes are grouped together within a feature dataset.

Raster data is stored as raster datasets; each raster image is stored as its own thematic layer. Multiple rasters are grouped into a raster catalog, or if the rasters are adjacent to each other, they are mosaicked into a single raster data set.

The table below shows the various kinds of spatial datasets that can be stored in the geodatabase.

GIS Data	Geodatabase Dataset
Coverage	Feature dataset containing feature classes
Shapefile	Feature class
Raster data (e.g., satellite images, air photos, scanned maps, and digital pictures)	Raster dataset and/or raster catalog
CAD data	Feature dataset containing feature classes
Surface modeling or 3D data	Terrain
Utility network data (e.g., water systems, gas pipelines, and telecommunication networks)	Geometric network
Transportation network data (e.g., street networks)	Network dataset
GPS coordinates	Table of x,y coordinates that can be generated into a feature class
Survey measurements	Cadastral fabric

Guidelines for File and Folder Management

The BSWM GIS Data Folder Structure (Spatial Data Set E) is organized in such a way that all those working on GIS data can retrieve and store datasets as needed. It is accessible at Server 2 of the BSWM Local Area Network. (\\server02\\GIS Database). However, the final datasets cannot be edited and staff that would like to add to the database can deposit their final data output at the UnSorted folder.

The file system of working (editable) spatial data can be accessed and stored, which for purpose of data security and integrity cannot be divulged in this manual. GIS staff will have to arrange with the Systems and Programming Section to access these working spatial data files from their desktop.

The folder and sub-folder structure of GIS Database is as follows:

Main Folder: GIS Database

Sub-folders:

Archives (back-up of spatial data of completed projects)
- Agricultural Profile

Geo Databases (current projects, updated spatial database)
- Atlas
  - *Currently, this folder contains:*
  - AgriAtlas.gdb
  - AgriBusinessLands.gdb
  - PhilHillShade.gdb
  - Basemaps.gdb
- CLUP
  - *Currently, this folder contains:*
  - CandonIlocos Sur
  - Valencia City
- Others
  - *Currently this folder contains:*
  - AgribizLand.gdb
  - BFAR.gdb
  - BPRE.gdb
  - DPWH.gdb
  - HVCC.gdb
  - Livestocks.gdb
  - PhilRice.gdb
- Projects
  - *Currently, this folder contains:*
  - LAPADI_Albay.gdb

Layer Files (this serves as back-up of various project files arranged according to thematic layer, not according to project):
- Basemaps
- Land
- Others
- Soil
- Water

Map Documents

Miscellaneous
- Excel Files
  - *This currently contains:*
  - El Nino Vulnerability

Philippine super regions
Provincial codes
SMU
Valencia suitability
Legends
Logo
This currently contains:
BSWM
DA
SRDC
MDB
Tables

PDF Maps (completed maps for public consumption)
Agriculture Atlas

Published Maps (thematic maps, not in PDF format)

Styles (commonly used set of symbols and map elements
used in map composting)

Templates (sample data and style files for use by map compositors
as example of professional-grade maps)

UnSorted (incoming spatial data/completed projects yet to be archived)

The folder contents are dynamic and what is presented here are what could be found at the time of the writing of this manual. The sub-folder file names (in italic bold), however, are permanent.

Guidelines for Naming of Files

Area or project name are most commonly used file names. Since an area has several thematic layers, the name of the location is usually added with the map (thematic layer) name to easily identify what the spatial data is all about. Map (thematic layer) name alone (e.g.: soils) is acceptable provided all the spatial data are in a singular folder that is named after the place or the project.

Project files should be organized in sub-folders according to project site, especially when there are several sites.

Year the spatial data was captured/edited is not required. However, SAFDZ spatial data would need the year, the administrative feature code (e.g.: b is for barangay), the polyline version, and the feature geometry (e.g.: shp for shapefile) or the project file in ArcView3, or the map document in ArcGIS when submitting the spatial

data to the Local Government Unit (LGU) co-sponsoring the SAFDZ-CLUP project. Please refer to HLURB GIS Cookbook for the guideline.

All spatial datasets submitted should include data dictionary and metadata. Please refer to the GIS Standards chapter for the parameters.

Data Sharing

Only processed thematic layers are shared with other government agencies, and made available to private users at cost. Normally, a discount of 50 percent is given to other government agencies and students as a matter of policy. A formal request is needed. Please refer to the Catalogue of BSWM Products and Services for data availability and the data costs.

Data Security

Irrespective of the value of the data set, but properly maintained spatial data increases through the years. The archived data could be considered as part of the daily operations and the value of these data could go beyond monetary considerations with time. It is therefore important to protect the GIS data from possible damages. Back-up is very important. Given a specific spatial data set, the following are the redundant files:

1. The original spatial data set, to be submitted to ISRIS by every GIS staff upon project completion for permanent archiving. Access is very limited. (Called *Spatial Data Set A)*

2. The original spatial data set back-up. Access is very limited. (Called *Spatial Data Set B).*

3. The original spatial data set, as produced by the GIS staff, normally resident in the staff's assigned desktop computer. Access is normally limited to the GIS staff handling the project. (Called *Spatial Data Set C*). Normally, the staff backs-it up either in the main server, in a compact disk, in a laptop, or in another file. This is called *Spatial Data Set C1*.

4. The working spatial dataset (*Spatial Data Set C1* resident in the main server, Server 2). Access is limited to GIS staff only. Please arrange with the Systems and Programming Section to be able to access the main folder and store the spatial data. This is called *Spatial Data Set D.*

5. The spatial dataset available to the BSWM staff with its sub-folders presented in this manual, resident in server 2 under the main folder "GIS Database" (\\server02\\GIS Database). This is called *Spatial Data Set E.* This is a very dynamic folder and normally contains current working or just completed GIS files. Ar-

chived files that BSWM staff want to be made available for their further processing or reproduction can be requested to be made available here. Once the files are inactive, the Systems and Programming staff would normally remove the file.

Manual on Map Standards & Symbols for GIS. GIS Mapping Standards. Juliet Manguerra and Rodelio Carating. Bureau of Soils and Water Management (3): 111—125, 2009

GIS Mapping Standards

Inter-Agency Task Force on Geographic Information

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The Inter-Agency Task Force on Geographic Information (IATFGI) was created on April 15, 1993 by virtue of NSCB Memorandum Order No. 01-93 to promote and coordinate the efficient development, management, and utilization of geographic information in the country. The National Mapping and Resource Information Authority (NAMRIA) is the IATFGI Chair and NSCB is the Co-chair. It has 36 active member agencies.

There is a Technical Working Group (TWG) on agriculture, environment, and natural resources composed of the Department of Environment and Natural Resources (chair), Forest Management Bureau, Bureau of Soils and Water Management, Protected Areas and Wildlife Bureau, Philippine Institute of Volcanology and Seismology, Philippine Atmospheric, Geophytsical, and Astronomical Services Administration, Mines and Geo-Sciences Bureau, and the National Statistical Coordination Board. There is a separate TWG for land and surveys, for infrastructure and utilities, for socio-economics, and for research, training, and technology

The IATFGI functions are— (1) Review policies, directions, thrusts, programs and projects related to the management of the Geographic Information System (GIS); (2) Determine issues and problems affecting the development of GIS in the country and recommend measures to enhance its development; (3) Recommend appropriate mechanism for coordinating various agencies involved in geographic information and their institutionalization; (4) Conduct inventory of geographic information holdings and projects; (5) Develop and recommend minimum standards for GIS exchange and standard methodologies, concepts, definitions, for universal adoption by all government agencies in the generation of geographic information; and (6) Create technical working groups as maybe needed for specific purposes.

A major and important activity is the formulation and standardization, as well as recommendation and endorsement of guidelines, resolutions, and policies to facilitate data exchange, processing, and integration; conduct of periodic inventory on data holdings, development of GIS technology, and GIS projects.

Since this is only a task force, there are moves to replace and empower IATFGI as NAMRIA does not have the appropriate mandate and mechanisms for coordi-

nation to geographic information sharing by various agencies. Two aspects being looked into is empowering NAMRIA to be able to accommodate the IATFGI structure, and amend the Executive Order which created the National Information Technology Council to expand functions and membership.

At any rate, IATFGI has come up with guidelines on data sharing (1994), on data classification (1995), and on map scales and map projections (1994).

Framework Data Sets for the Philippine National Geographic Information Infrastructure (NGII) for Natural Environment

The framework data sets include for primary reference, administration, natural environment, socio-economic, and built environment. However, for purpose of this article, we will detail only the data sets for the natural environment:

Theme	Description	F	National Custodian
Earth's land surface	Vertical distance from the earth's surface to a base defined by Philippine Height Datum	*	NAMRIA
Coastline	The limit of land features at mean high water level	*	NAMRIA
River Catchments/Drainage Areas	Boundaries of catchments / drainage areas	*	NAMRIA (with DENR-FMB)
Streamlines and Inland Water Bodies	Location of water courses and all inland water bodies	*	NAMRIA (with DENR-NWRB)
Bathymetry	Vertical distance of earth's land surface from base defined by Lowest Astronomical Tide		NAMRIA
Geology	Boundaries and classification of geological units, both terrestrial and marine		DENR-MBG with PHIVOLCS
Mineral Resources	Boundaries and classification of mineral occurrence, both terrestrial and marine		DE NR-MGB
Hydrogeology	Boundaries and classification of aquifers		DENR-MGB
Oceanography	Boundaries of physical and chemical characteristics of parts of ocean		NAMRIA (with MSI)
Soils Classification	Boundaries and classification of terrestrial soil resources		DA-BSWM (with DENR-FMB)
Biodiversity Regions	Interim biogeographic regionalization of the Philippines (terrestrial, marine, coastal)		DENR-PAWB
Vegetation Classification (Flora)	Boundaries and areas of vegetation and associated entity description of dominant life forms (terrestrial , marine)		NAMRIA (with DENR-FMB, DA, CRMP)
Animals (Fauna)	Classification and location of native and introduced animals (terrestrial, marine)		DENR-PAWB
Marine Benthic Substrate Classification	Boundaries and classification of benthic substrates		DA-BFAR
Land and marine systems	Areas or groups of like topology, soils and vegetation (often modelled) throughout which can be recognized a recurring pattern		DENR-NAMRIA (with BSWM)
Areas subject to natural hazards	Spatial definition of such with attribute data on periodic level of probability (include permanent danger zones)		NDCC-OCD (with Phivolcs, DENR-MGB, PAGASA

Technical Standards

(Source: http://www.bakosurtanal.go.id/upl_document/konsesus07nop2006/ Standar_Internasional/FundamentalDataset_Filipina.pdf)

A National Geographic Information Structure requires standards in the following areas: reference systems, data models, data dictionaries, data quality, data transfer, and metadata.

The International Standards Organization (ISO) established a committee structure (ISO TC/211) for geographic information standardization as a new field of technical activity. This ISO provides the framework for both international and national geographic information standardization. Some of the works has been done by the IATFGI and other countries in the development of standards.

Reference Systems

The geographic reference system, or geodetic datum, is a fundamental standard to enable integration of geographic information. The availability of Global Positioning System (GPS) technology has greatly improved geodetic knowledge at the national, regional, and global levels, enabling computation of a precise geocentric datum. Within a national geographic information infrastructure, the two key requirements are for the fundamental datasets to be stored on a single accurate national reference system, and for the relationship between the national and geocentric reference systems to be well defined.

The development and maintenance of a national geographic reference system, in the era of satellite positioning system, requires a technological infrastructure of its own. The core of this geodetic infrastructure is a "fiducial network" of GPS stations, linked to the national and preferably also the regional and global geodetic systems. In addition to the fundamental datasets, this geodetic infrastructure also supports the geoscientific and navigational users of satellite positioning technology.

The NGII shall use the new Philippine Reference System (PRS) as its geographic reference system making it compatible with modern satellite-based positioning systems. The Philippine Reference Systemn of 1992 is a is a homogeneous national network of *geodetic control points* (GCPs), marked by survey monuments or mojons (a mark on land made by concrete wherein the latitude and longitude coordinates are written for land survey use), that has been established using Global Positioning System (GPS) technology. GPS is an all-weather, high precision, global satellite positioning system that revolutionized navigation and surveying operations.

By virtue of EO 45 under the Ramos Administration, PRS92 became the standard reference system for all surveying and mapping activities in the Philippines. The order also mandated that all new surveys and maps shall be referred to the new network and all old surveys shall be integrated into it. Subsequently, it was amended by EO 280 extending its full implementation by 2005. In order to complete the adoption

and integration of old surveys into the new system until year 2010, EO 321 was issued by President Gloria Macapagal Arroyo. The NAMRIA, Lands Management Bureau, and the DENR-Regional Operations Committees are the primary agencies responsible in executing the Order. DENR Administrative Order No. 2005-13 provides the overall guidelines in the implementation of the PRS92 program.

Data Models

A data model in geographic information systems is a mathematical construct for representing geographic objects or surface as data. For example, the vector data model represents geography as collection of points, lines, and polygons; the raster data model represent geography as cell matrixes that store numeric values; and the TIN data model represents geography as sets of contiguous, non-overlapping triangles.

There are two levels to a data model standard—the conceptual data model and the logical data model (or data structure). A third level, the physical data model or file structure is implemented in the data transfer standard. The conceptual model provides a schema for the representation of the real world in the form of geographic information. The schema provides a semantic structure for the relationships between the various datasets. The conceptual level is then mapped into one or more logical datasets, which specify how the relationships are to be defined. This is the level at which, for example, a topological or raster data structure would be specified.

For the purpose of this manual, we would like to share the ISO/ TC211 portion on Data Models (Reference: *http://www.isotc211.org*) to enable BSWM GIS outputs to be ISO-compliant. The ISO /TC 211 Data Model Standards builds on the domain reference model of ISO 19101. It provides a family of abstract conceptual schemas for describing the fundamental components of features as elements of geographic information. ISO 19109 specifies a general feature model for integrating these components into features and provides rules for doing so in an application schema. ISO 19107 specifies UML classes for representing the spatial characteristics of features as composites of geometric and/or topographical primitives. ISO 19108 does the same for the temporal characteristics of features and also specifies classes for describing relevant temporal reference systems. ISO 19123 provides a schema for an alternative representation of spatial information as coverage, in which non-spatial attributes are assigned directly to geometric objects rather than to features composed of such objects. ISO 19141 extends ISO 19107 to support the description of moving geometric objects, but will not be discussed in this manual because we have no moving geometric objects. This, however, should not prevent BSWM from conducting time series GIS type studies. ISO 19137 provides a profile of ISO 19197 that is limited to describing features as simple geometric primitives of 0, 1, or 2 dimensions.

ISO 19109:2005 Geographic Information—Rules for Application Schema. An application schema defines content and structure of data; and operations for ma-

nipulating and processing data by an application. The purpose is to provide a computer –readable data description defining the data structure, which makes it possible to apply automated mechanisms for data management; and to achieve a common and correct understanding of the data, by documenting the data content of the particular application field, thereby making it possible for unambiguously retrieve information from the data. The International Standard does not standardize application schemas; it only defines rules for creating application schemas in a consistent manner (including consistent definition of features) to facilitate the acquiring, processing, analyzing, accessing, presenting, and transferring of geographic data between different users, systems, and locations.

An application schema is expressed in a conceptual schema language (CSL). Clause 7 includes a General Feature Model (GFM) expressed in the Unified Modeling Language (UML) that defines the concepts required to describe types of features. A feature type definition maybe documented in feature catalogues. The GFM is a model of the concepts required to classify a geographic view of the real world. UML has its own model of concepts (metamodel). As both the GFM and the UML metamodel deal with classification, the concepts are very similar; with one big difference. The concepts in GFM establish a basis for the classification of features; whereas the UML metamodel provides a basis for classification of any kind. Besides a name and a description, a feature type is defined by its properties such as feature attributes, feature association roles characterizing the feature type; and defined behaviour of the feature type. All these are expressed as UML metaclasses in the GFM. Additional concepts are feature associations between the feature type and itself or other feature types; generalization and specialization relationships to other feature types; and constraints on the feature type.

ISO 19107:2003 Geographic Information—Spatial Schema. Vector data consists of geometric and topological primitives used, separately or in combination, to construct objects that express the spatial characteristics of geographic features. The International Standard deals only with vector data.

In the model defined, spatial characteristics are described by one or more spatial attributes whose value is given by a geometric object (GM_Object) or a topological object (TP_Object).

Geometry provides the means for the quantitative description, by means of coordinates and mathematical functions, of the spatial characteristics of features, including dimension, position, size, shape, and orientation. Geometry is the only aspect of the geographic information that changes when the information is transformed from one geodetic reference system or coordinate system to another.

Topology deals with the characteristics of geometric figures that remain invariant if the space is deformed elastically and continuously. Topology is commonly used to describe the connectivity of an n-dimension graph, a property that is invariantly un-

der continuous transformation of the graph. Computational topology provides information about the connectivity of geometric primitives that can be derived from the underlying geometry.

Spatial operators are functions and procedures that use, query, create, modify, or delete spatial objects. The International Standard defines the taxonomy of these operators in order to create a standard for their definition and implementation. The goals are to define operators unambiguously, so that diverse implementations can be assured to yield comparable results within known limitations of accuracy and resolution; use these definitions to define a set of standard operations that will form the basis of compliant systems and thus act as benchmark set for validation of compliance; and define an operator algebra that will allow combinations of the base operators to be used predictably in the query and manipulation of geographic data.

ISO 19123:2005 Geographic Information—Schema for Coverage Geometry and Functions. The International Standard defines a conceptual schema for the spatial characteristics of coverages. Coverages support mapping from a spatial, temporal, or spatio-temporal domain to feature attribute values where feature attribute types are common to all geographic positions within the domain. A coverage domain consists of a collection of direct positions in a coordinate space that may be defined in terms of up to three spatial dimensions as well as temporal dimension. Coverages are the prevailing data structures in a number of application areas such as remote sensing, meteorology, and mapping of bathymetry, elevation, soil, and vegetation.

Historically, geographic information has been treated in terms of two fundamental types called vector data and raster data. Vector data deals with discrete phenomena, each of which is conceived of as a feature and represented by a set of one or more geometric primitives (points, curves, surfaces or solids). Normally, a single feature is associated with a single set of attribute values. Raster data, on the other hand, deals with real-world phenomena that vary continuously over space. It contains a set of values, each associated with one of the elements in a regular array of points or cells. It is associated with a method for interpolating values at spatial positions between the points or within the cells.

A coverage is a feature that has multiple values for each attribute type, where each direct position within the geometric representation of the feature has a single value for each attribute type. A coverage is both a feature and a function. A coverage may represent a single feature or a set of features.

A coverage domain is a set of geometric objects described in terms of direct positions. It may be extended to all of the direct positions within the convex hull of that set of geometric objects. The direct positions are associated with a spatial or temporal coordinate reference system. The geometric objects may exhaustively partition the domain, and thereby form a tessellation such as a grid or a TIN. Point sets and

other sets of non-conterminous geometric objects do not form tessellations. Coverage subtypes may be defined in terms of their domains.

The range of a coverage is a set of feature attribute values. It may be either a finite or a transfinite set. Coverages often model many associated functions sharing the same domain. Therefore, the value set is represented as a collection of records with a common schema.

A discrete coverage has a domain that consists of a finite collection of geometric objects and the direct positions contained in those geometric objects. A discrete coverage maps each geometric object to a single record of feature attribute values. The geometric object and its associated record form a geometry value pair. A discrete object is thus a discrete or step function as opposed to a continuous coverage. A discrete coverage maybe represented as a collection of ordered pairs of independent and dependent variables. Each independent variable is a geometric object and each dependent variable is a record of feature attribute values. A soil map is an example and each soil mapping unit (the polygon) is a discrete coverage.

A continuous coverage has a domain that consists of a set of direct positions in a coordinate space. A continuous coverage maps direct positions to value records. An example is a coverage that maps direct positions in a watershed to their temperature at noon today. Both the domain and the range may take an infinite number of different values. This continuous coverage would be associated with a discrete coverage that holds the temperature values observed at a set of agromet stations.

A feature attribute value maybe of any data type. However, evaluation of a continuous coverage is usually implemented by interpolation methods that can be applied to numbers or vectors. Other data types are almost always associated with discrete coverages.

The coverage schema is organized into seven packages with inter-package dependencies - Coverage core, Discrete coverages, Thiessen polygon, Quadrilateral grid, Hexagonal grid, TIN, Segmented curve. These are described in clauses 5 to 11.

ISO 19198:2002 Geographic Information—Temporal Schema. This International Standard defines the standard concepts needed to describe the temporal characteristics of geographic information as they are abstracted from the real world. Temporal characteristics of geographic information include feature attributes, feature operations, feature associations, and metadata elements that take a value in the temporal domain.

Temporal geometric and topological objects are used as values for the temporal characteristics of features and data sets. TM-Object is an abstract class that has two sub-classes. TM-Primitive is an abstract class that represents a non-decomposed element of geometry or topology of time. There are two sub-classes of TM-Primitive— a

TM_Geometric Primitive that provides information about temporal position and a TM_Topological Primitive that provides information about connectivity in time. A TM-Complex is an aggregation of TM_Primitives.

The two geometric primitives in the temporal dimensions are the instant and the period. These primitives are defined analytically in the case of time measured an interval scale, and analogically in the case of time measured on an ordinal scale.

A topological primitive represents a single on-decomposable element of topology and its relationships to other topological primitives within a topological complex. The two topological primitives relevant for temporal information are the node which is a 0-dimensional, and the edge which is one-dimensional. In the temporal schema, these are represented by two sub-classes of TM_Topological Primitive—the TM_Node and the TM_Edge. When an application includes information about temporal position as well as connectivity, a TM_Topological Primitive maybe associated with a TM_Geometric Primitive of the same dimension.

A value in the time domain is a temporal position measured relative to a temporal reference system. ISO 8601 specifies the use of the Gregorian Calendar and 24-hour local or Coordinated Universal Time (UTC) for information interchange. This is the primary temporal reference system for use with geographic information. A different temporal reference system may be appropriate for some applications of geographic information.

ISO 19137:2007 Geographic Information—Core Profile of the Spatial Data. This international standard defines a core profile of the spatial schema specified in ISO 19107 that specifies minimal set of geometric elements necessary for the efficient creation of application schemata. The International Standard supports data types for geometric primitives of 0, 1, and 2 dimensions. The International Standard is limited to applications in which there is a 1:1 mapping between features and geometric primitives, all geometric primitives are referenced to a single coordinate reference system, all curves are composed of line segments, and all surfaces are composed of planer facets.

Data Dictionaries

Data Dictionary refers to a document containing information about series of datasets. A Data Dictionary is a form of metadata or “data about the data”. Information found in a data dictionary typically are names of the data, information about the attributes, and information about any relational tables to the spatial datasets.

The data dictionary is built on the conceptual data model. It provides standard definitions for the spatial and attribute components of the fundamental data sets. For example, the feature “road” may have a range of attributes such as class, surface, and with; and the attribute “class” may have a range of values such as princi-

pal, secondary, and minor. All these terms must be unambiguously defined in a data dictionary to enable accurate interpretation and efficient integration of data in GIS applications. Data dictionaries must be developed for each fundamental dataset and cross-referenced to ensure consistency.

As more and more data is produced, and the application and communication technologies become more efficient, the lack of semantic standards such as data dictionaries has become a larger impediment to GIS success than the lack of tehnology-related standards such as data transfer.

The IATFGI is coordinating the development of data dictionaries. There are groups currently working on data dictionaries for topography, cadastre, utilities, streets, addresses, geosciences, etc. These groups are the IATFGI technical working groups on land and surveys, socio-economic, infrastructure and utilities, agriculture and environment.

Sample BSWM data dictionary in table format:

Spatial Data Type:	SOILS
Data Layer:	Soil Map of Bulacan
Layer Name:	SoilBUL1984
Description:	Soil map at soil series level, 1:50,000
Source/Conversion Method	Soil Map of Bulacan Province 14 map sheets including legend, 1984 Bureau of Soils, Ministry of Agriculture Digitized on MO-YR using ARCInfo
Data Generator:	Soil Survey Division
Positional Accuracy	
Feature Type(s) and Attributes	ITEM NAME WIDTH TYPE N-DEC DESCRIPTION INDEX SMU_ID 30 C - Soil Series Name D 5 N 2 Soil Depth OM 5 N 2 Organic Matter CEC 5 N 2 Cation Exch Cap TX 30 C - Soil Texture EC/FC 5 N - Erosion/Flooding Class
Maintenance/Data Update	Data layer requires no maintenance (soils follow geologic time). More detailed soil surveys in certain areas conducted later on are not inputted but available as separate layers.
Other information	No layer for soil sampling points (point data). Please refer to soil survey reports for locations of typifying pedons. Detailed soil info at farm level for JICA techno-demo farm in San Indefonso Bulacan, 1:20,000 (2004) available Detailed soil map of San Ildefonso research station, 1:25,000 (1996) available Detailed soil map of San Jose del Monte City 1:50,000 (2007) available

ISO 19110:2005 Geographic Information—Methodology for Feature Cataloguing. This International Standard defines the methodology for developing catalogues containing definitions of feature types and their property types including feature attributes, feature associations, and feature operations.

A feature catalogue presents the abstraction of reality represented in one or more sets of geographic data as a defined classification of phenomena. The basic level of classification in a feature catalogue is the feature type. A feature catalogue is to be available in an electronic form for any set of geographic data that contains features. A feature catalogue may also comply with the specifications of this International Standard independent of any existing set of geographic data. The feature catalogue includes definitions and descriptions of all feature types contained in the data, including any feature attributes and feature associations contained in the data, and optionally including feature operations that are supported by the data. These should be identified by a name that is unique within that feature catalogue. Definitions are given in a natural language. Each feature type is identified by a name and may also be identified by an alphanumeric code that is unique within that catalogue and it may have a set of aliases.

Data Quality

Geographic data quality may be descriptive, prescriptive, or both. A descriptive standard is based on the concept of "truth in labelling", requiring data producers to report what is known about the quality of the data. This enables data users to make an informed judgment about "fitness for purpose" of the data. A descriptive data quality standard mahy require producers to provide information on the following five key characteristics: lineage, positional accuracy, attribute accuracy, logical consistency, and completeness. A prescriptive standard would define quality parameters for each characteristics, for a particular application.

Descriptive quality standards are being developed. A quality statement is a key element in the metadata standard, because it enables potential users of data to assess whether the data held is fit for the purpose to which they intend to use it. However, for fundamental datasets, prescriptive standards maybe required and that wide community consultation is required to determine those standards. Quality standards shall be addressed in the community consultation on fundamental datasets.

ISO 19113:2002 Geographic Information—Quality Principles. The objective of this International Standard is to provide principles for describing the quality for geographic data and concepts for handling quality information for geographic data.

The purpose of describing data quality is to facilitate the quality of geographic dataset best suited to application needs or requirements. Complete description will encourage the sharing, interchange and use of appropriate geographic datasets which can be viewed as a commodity or product.

The data of quality is described using two components—(1) data quality elements and sub-elements that describe how well a dataset meets the criteria in its product specifications and provide quantitative quality information; and (2) data quality overview elements providing general quality information.

The following are the data quality elements used to describe how well a dataset meets the criteria set forth in its product specifications: (1) completeness—presence and absence of features, their attributes and relationships; (2) logical consistency—degree of adherence to logical rules of data structure, attribution, and relationships; (3) positional accuracy; (4) temporal accuracy; and (5) thematic accuracy. Additional data quality elements may be created to describe a component of the quantitative quality of a dataset not addressed in the International Standards.

ISO 191114:2003 Geographic Information—Quality Evaluation Procedures. This International Standard provides a framework of procedures for determining and evaluating quality that is applicable to digital geographic datasets. Data producers and data users may view data quality from different perspectives. Conformance quality levels can be set using the data producer's product specifications or a data user's quality requirements. The process of evaluating data quality is a sequence of steps to produce and report a data quality result.

A data quality evaluation procedure is accomplished through the application of one or more data quality evaluation methods which are divided into two main classes—direct and indirect. Direct methods determine data quality through the comparison of the data with internal or external reference information. Indirect methods infer or estimate data quality using information on the data such as lineage.

Qualitative data results are reported as metadata in compliance with ISO 19115 which contains the related model and data dictionary.

ISO/TS 19138:2006 Geographic Information - Data Quality Measures. This technical specification defines a set of data quality measures for the data quality sub-elements identified in ISO 19113. Multiple measures are defined for each data quality sub-element, and the choice of which to use will depend on the type of data and its intended purpose. The data quality measures are structured so that they can be maintained in a register established in conformance with ISO 19135.

Data Transfer

Transfer standards provide an intermediate format for the transfer of data between different computing environments. They comprise a set of rules for encoding data into fields, records, and files for transfer via a specified media. A data model is a prerequisite to developing of the encoding rules. The intermediate nature of transfer standards is an important characteristics—they are not intended to be prod-

uct or database structures. Transfer standards are optimized to achieve effective communication of all data and metadata, whereas product and database structures maybe optimized for efficiency of storage, application, or maintenance.

The transfer standard provides a GIS vendor-independent target for encoding data for output, and for decoding data for input. Vendor independence enables production and application agencies to utilize whichever hardware and software systems are the most cost effective for their needs, without compromising corporate government principles.

It is hoped that the ISO activity will result in an international geographic information transfer standard, which with government agencies and GIS vendor support, will facilitate effective data communications within and between nations. The Philippines actively participate in the work of ISO TC/211 to ensure that any international standard adopted is compatible with the Philippines.

The Philippines supports the adoption of the US Geographic Information Transfer Standard (SDTS). From *http://data.geocomm.com/sdts/* web site, STDS is a robust way of transferring earth-referenced data between dissimilar computer systems with the potential for no information loss. It is a transfer standard that embraces the philosophy of self-contained transfers, i.e. spatial data, attribute, georeferencing, data quality report, data dictionary, and other supporting metadata all included in the transfer.

The purpose of SDTS is to promote and facilitate the transfer of digital spatial data between dissimilar computer systems while preserving information. Implementation of SDTS is of significant interest to users and producers of digital spatial data because of the potential for increased access to and sharing of spatial data, the reduction of information loss in data exchange, the elimination of the duplication of data acquisition, and the increase in the quality and integrity of spatial data. SDTS is neutral, modular, growth-oriented, extensible, and flexible--all characteristics of an "open systems" standard.

It has six components—logical specifications, spatial features, ISO 8211 encoding, topological vector profile, raster profile, and point profile. To view each of these standards, one can access *http://mcmcweb.er.usgs.gov/sdts/standard.html*.

Metadata

A metadata standard will specify how data is described in the national directory and in data transfers. Characteristics to be described may include the data set name, content, coverage, quality and structure, and information on access procedures and restrictions. The metadata standard can be viewed as a microcosm of the other data standards, requiring (meta) data model, dictionary, quality and transfer specifications of its own.

The BSWM supports the concept of a national directory of geographic information and it is incumbent to develop metadata in conformity with national and international standards.

ISO 19115:2003 Geographic Information—Metadata. The objective of this international standard is to provide a structure for describing digital geographic data. The International Standard defines metadata elements, provides a schema, and establishes a common set of metadata terminology, definitions, and extension procedures. Metadata is applicable to independent datasets, aggregations of datasets, individual geographic features, and the various classes of objects that compose a feature. Metadata is composed of one or more Metadata Sections (UML Packages) containing one or more Metadata Entities (UML classes). The International Standard defines an extensive set of metadata elements; but typically only a subset of the full number of elements is used. There is a list of core metadata elements required to identify a dataset, for catalogue purposes; the list answers the following questions: "Does a dataset on a

Core metadata for geographic datasets:

Dataset title (M) (MD_Metadata>MD_DataIdentification.citation> Cl_Citation.title)	**Spatial representation type (O)** (MD_Metadata> MD_DataIdentification.spatialRepresentationType)
Dataset reference date (M) (MD_Metadata>MD_DataIdentification.citation> Cl_Citation.date)	**Reference System (O)** (MD_Metadata > MD_ReferenceSystem)
Dataset responsible party (O) (MD_Metadata>MD_DataIdentification.pointOfContact> Cl_ResponsibleParty)	**Lineage (O)** (MD_Metadata > DQ_DataQuality.lineage>Ll_Lineage)
Geographic location of the dataset (by four coordinates or by geographic identifier) (C) (MD_Metadata>MD_DataIdentification.extent> EX_extent > EX_GeographicExtent > EX_GeographicBoundingBox or EX_Geographic Description)	**On-line resource (O)** (MD_Metadata > MD_Distribution > MD_DigitalTransferOption.onLine > Cl_OnlineResource)
Dataset language (M) (MD_Metadata > MD_DataIdentification.language)	**Metadta file identifier (O)** (MD_Metadata.fileIdentifier)
Dataset character set (C) (MD_Metadata > MD_DataIdentification.characterSet)	**Metadata standard name (O)** (MD_Metadata.metadata.StandardName)
Dataset topic category (M) (MD_Metadata >MD_DataIdentification.topic.Category)	**Metadata standard version (O)** (MD_Metadata.metadata.StandardVersion)
Spatial resolution of the dataset (O) (MD_Metadata > MD_DataIdentification.spatialResolution> MD_Resolution.equivalentScale or MD_Resolution.distance	**Metadata language (C)** (MD_Metadata.language)
Abstract describing the dataset (M) (MD_Metadata > MD_DataIdentification.abstract)	**Metadata character set (C)** (MD_Metadata.characterSet)
Distribution format (O) (MD_Metadata > MD_Distribution > MD_Format.name and MD_Format.version)	**Metadata point of contact (M)** (MD_Metadata.contact > Cl_ResponsibleParty)
Additional extent information for the dataset (vertical and temporal) (O) (MD_Metadata > MD_DataIdentification.extent > EX_Extent > EX_TemporalExtent or EX_VerticalExtent)	**Metadata date stamp (M)** (MD_Metadata.dateStamp)

specific topic exist (what)?"; "for a specific place (where)?"; and "a point of contact to learn more about or order the dataset (who)?". Using the recommended optional elements in addition to the mandatory elements will increase interoperability, allowing users to understand without ambiguity the geographic data and the related metadata provided by either the producer or the distributor.

CLUP GIS Guidebook

The Comprehensive Land Use Plan (CLUP) GIS Guidebook was prepared by the Housing and Land Use Regulatory Board (HLURB) to assist the local government units (LGUs) on the preparation of their development plans. Since BSWM is involved in the updating of Strategic Agriculture and Fisheries Development Zones (SAFDZs) under the Agriculture and Fisheries Modernization Act (AFMA) for integration in the CLUP, it is important for SAFDZ-CLUP integration project staff to be aware of the CLUP GIS Guidebook which is commonly referred to as the GIS Cookbook.

The GIS Cookbook is Volume 3 in the revised HLURB CLUP Guidelines portfolio and accordingly synchronized with Volumes 1 and 2. This is the product of the various series of consultations and workshops held nationwide involving a multidisciplinary cross-section of potential users of the book, ranging from LGUs, the national government agencies involved in planning, the academe, private individuals and institutions involved in the planning profession. The various drafts have gone through participative sessions after which comments and recommendations have been incorporated whenever applicable and feasible.

The GIS Cookbook is available at the internet and the URL address is—*http://www.cookbook.hlurb.gov.ph/*. While this BSWM GIS map symbology manual focuses on GIS application in soils, it is important for this manual users to browse through the GIS Cookbook for comprehensive and state-of-the art GIS mapping standards as currently practiced in the Philippines, especially by those in the development planning sector. The soils section is Chapter 4.08.02 and basically discusses the procedures for soil suitability assessment for urban land use based on slope, erosion, and stoniness for which criteria have been set. The Cookbook pinpoints BSWM as the spatial data custodian for the soils; but take note that this is for urban use and BSWM is under the Department of Agriculture. Much of our available spatial database and evaluation criteria employed are for agricultural use. Arrangements for in-situ field survey may have to be arranged with the LGU planners for more accurate data generation for soils in the urban areas. The data analysis step assumes users are familiar with thematic layering in GIS. A chapter disclaimer clarifies that this is first attempt and intended to be used hand-in-hand with Volumes 1 and 2. More updated versions are expected to be released in the future. Nevertheless, SAFDZ-CLUP integration project staff should not miss this chapter when assessing urban expansion areas to be calculated from allowable conversion percentages for areas under SAFDZs based on surveyed data.

Chapter 4.09.04 is the chapter on Land Management: Strategic Agriculture and Fisheries Development Zones (SAFDZ). As in the soils chapter, this is also the first version and subject to further refinements. The SAFDZ thematic layer is to be acquired from BSWM. SAFDZ is a subset of the Network of Protected Areas for Agriculture and Agro-Industrial Development (NPAAAD) and the SAFDZ component of interest within the context of NPAAAD is a second thematic layer expected to be available to GIS users at the LGU level. ALMED and ISRIS of BSWM were identified in the GIS Cookbook as data custodians. NPAAAD are still considered prime agricultural lands and this second layer can be used later in the risk and in the suitability analysis, where any area declared as NPAAAD will be a constraint and hence should be excluded for urban use. Since this GIS Cookbook is hinged on overall CLUP that includes Volumes 1 and 2, only areas delineated outside of NPAAAD would be available for urban development. Inside the NPAAAD, the data does not need thorough analyses. Section 10 of RA 8435 requires LGU to integrate SAFDZ into their CLUP. To facilitate such undertaking, the GIS Cookbook identifies BSWM to provide the LGUs with the necessary technical assistance. A Memorandum of Agreement (MOA) is normally executed between the municipality/city concerned and BSWM for technical assistance on SAFDZ integration into the CLUP. Much of the spatial data requirement for SAFDZ is within the BSWM mandate and covered by this BSWM manual on GIS symbology. The GIS Cookbook identifies only the spatial datasets required. *Take note that the SAFDZ symbols and map unit color codes are fixed in the GIS Cookbook and BSWM staff conducting SAFDZ-CLUP integration should adhere to the standards*:

Spatial Data	Symbols
1– Strategic Crop Sub-Development Zone	165-254-164
2– Strategic Livestock Sub-Development Zone	151-71-73
3—Strategic Fishery Sub-Development Zone	0-0-255
4—Strategic Integrated Crop/Livestock Sub Development Zone	2-219-0
5—Strategic Integrated Cop/Fishery Sub-Development Zone	1-129-0
6—Strategic Integrated Crop/Livestock/Fishery Sub-Development Zone	254-194-194
7—Strategic Integrated Fishery and Livestock Sub-Development Zone	186-165-0
8—Remaining NPAAAD	254-248-164
9—Agro-Forestry Zone	254-172-0
10—Watershed/Forestry Zone	255-0255
11—Built-up Areas	165-165-165
R/L—River wash	164-249-254
EZ– Economic Zone	
MR—Military Reservation	255-0-0
SD– Sand dunes/beach area	
NIPAS	

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