ESC MANUAL FOR SABAH & SARAWAK

IR AZMAN ABU BAKAR
(PAOR)

PROBLEMS…PROBLEMS…

Erosion only a few feet from the kitchen of their longhouses, on the banks of Baleh River, Kapit.

River silted by erosion due to deforestation for oil palm plantations, Niah National Park, Sarawak, Malaysia.

…….AND MORE PROBLEMS

A 5.9-magnitude earthquake has caused soil erosion and rockfall in at least two rivers, while heavy mudflow has affected water supply in the Kota Belud and Ranau districts.

Developer Victor Paul was reported telling that Tanjung Aru beach has eroded 50 meters in the last 40 years during the 5th Sabah International Surveyors'.

Issues

- At the moment, there is no specific ESC guidelines/manual for Sabah & Sarawak.
- There are however, motley collections of research papers/studies/journals been published by respective researchers – but they do not transcend to engineering practitioners and others who are involved in ESC practices.
- The existing Guideline for Erosion & Sediment Control in Malaysia 2010 should be used as a precursor to develop the guideline for Sabah & Sarawak.

Some examples of research papers

ASEAN Review of Biodiversity and Environmental Conservation (ARBEC) January-March 2003

LAND USE AND SOIL EROSION IN TIKOLOD, SABAH, MALAYSIA

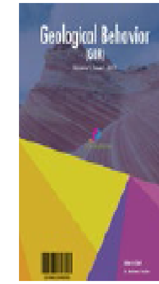
B. Gregersen[1], J. Aalbæk[1], P.E. Lauridsen[2], M. Kaas[3], U. Lopdrup[4], A. Veihe[5] and P. van der Keur[5]

ESTEEM, Vol. 4, No. 1, 2008, 45–56

The Application of Rainfall Erosivity Index to Determine Landslide Risk in Sabah, Malaysia

Hamjah Rusli
Roslan Zainal Abidin
Mohd. Fairuz Bachok
Noorsuhada Md. Nor

ISSN: 2521-0890 (Print)
ISSN: 2521-0491 (Online)



Contents List available at RAZI Publishing
Geological Behavior (GBR)
Journal Homepage: http://www.razipublishing.com/journals/geological-behavior/
https://doi.org/10.26480/gbr.01.2017.01.05

CrossMark

GIS Application for Comprehensive Spatial Soil Erosion Analysis with MUSLE Model in Sandakan Town Area, Sabah, Malaysia

Rodeano Roslee*, Kawi Bidin, Baba Musta, Sanudin Tahir, Felix Tongkul, Mohd Norazman Norhisham
Faculty of Science and Natural Resources, University Malaysia Sabah, UMS Road, 88400 Kota Kinabalu, Sabah, Malaysia
**Corresponding Author*
Email Address: rodeano@ums.edu.my (Rodeano Roslee)

UNIMAS E-Journal of Civil Engineering, Vol. 2 (2) 2011

Soil Erosion and Sediment Yield of a Sanitary Landfill Site – A Case Study

Oon, Y.W.[1], Chin, N.J.[2] and Law, P.L.[3]

Issues (2)

- To ease the calculation of USLE and MUSLE, these factors need to be pre-determined
  a. Rainfall erosivity factor, R
  b. Soil erodibility factor, K
  c. Slope length and steepness factor, LS
  d. Cover management and erosion control practice factors, C and P.
  e. Curve number, CN and surface runoff, V
  f. Peak discharge, Qp

Issues (3)

- Among the many factors, computation of R factors appeared to be the most complicated due to the rainfall data requirement
- There is a set of complete isoerodent maps for Peninsular Malaysia, but none for Sabah & Sarawak.

Development of rainfall erosivity isohyet map for Peninsular Malaysia

CHENG SIANG LEOW, *Research Officer, River Engineering and Urban Drainage Research Centre (REDAC), Universiti Sains Malaysia, Engineering Campus, Seri Ampangan, 14300 Nibong Tebal, Penang, Malaysia. Email: redac21@eng.usm.my*

AMINUDDIN AB. GHANI, *Professor & Deputy Director, REDAC, Universiti Sains Malaysia, Engineering Campus, Seri Ampangan,14300 Nibong Tebal, Penang, Malaysia,. Email: redac02@eng.usm.my*

NOR AZAZI ZAKARIA, *Professor & Director, REDAC, Universiti Sains Malaysia, Engineering Campus, Seri Ampangan,14300 Nibong Tebal, Penang, Malaysia,. Email: redac01@eng.usm.my*

ROSLAN ZAINAL ABIDIN, *Vice President, Kuala Lumpur Infrastructure University College, Unipark Suria, 43000 Kajang, Selangor, Malaysia*. Email: roslan@kliuc.edu.my

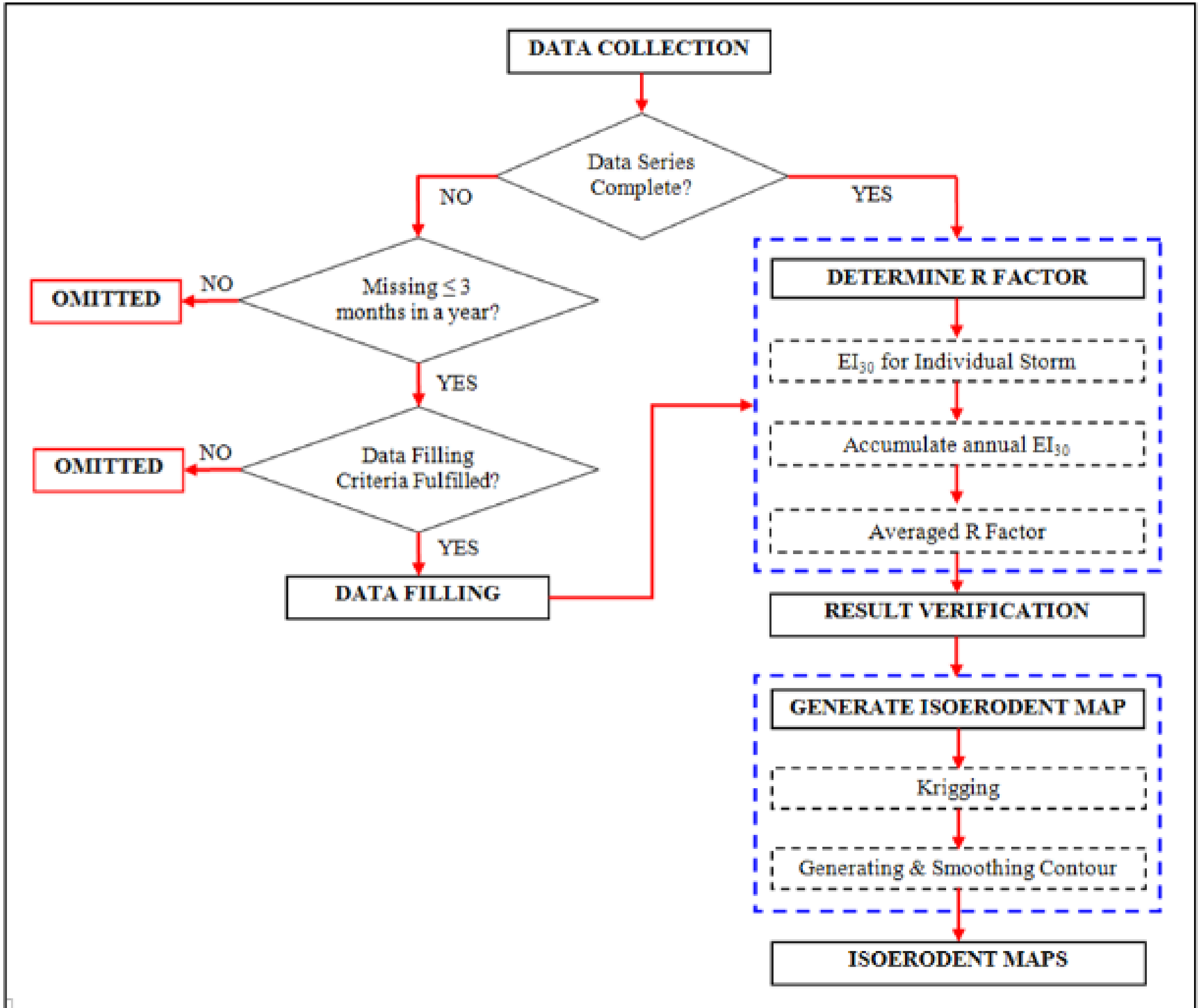
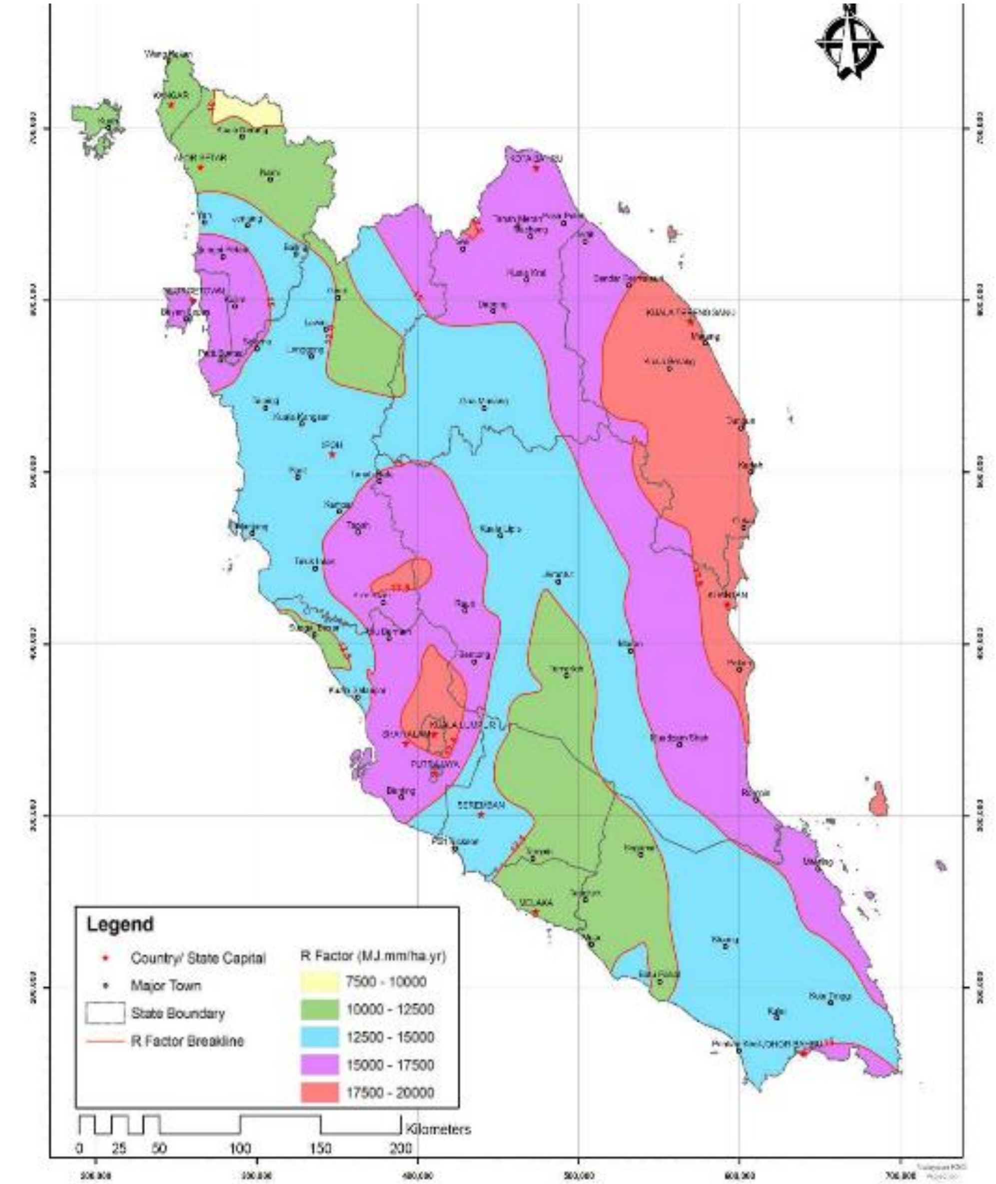
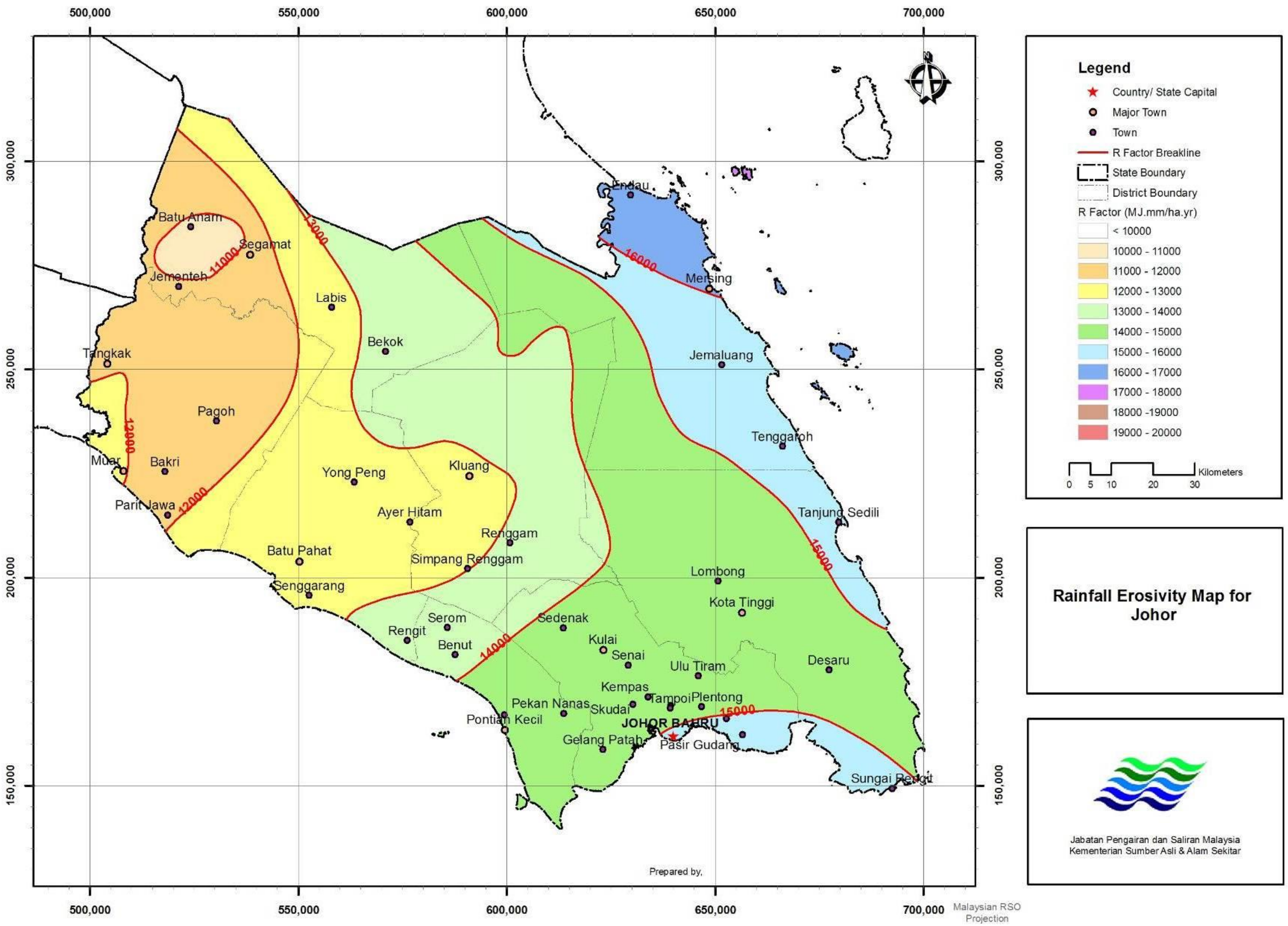


Figure 2: Flow chart of producing rainfall erosivity map

Isoerodent map, R factor for Peninsular Malaysia



Isoerodent map, R factor for Johor



What's happening in Sabah & Sarawak?

4.1 Rain Erosivity Factor (R)

The rate of soil erosion is associated with rain seepage strength to break the soil surface and cause surface runoff (water runoff) occurs (Morgan et al., 1998). R values were calculated based on the equation that was introduced by Morgan (1974), by referring to the annual average rainfall and intensity data for 30 minutes at a maximum for each rain gauge stations in Sandakan Town, which obtained from the Malaysian Meteorological Department, Kota Kinabalu branch. Equation (3) by Morgan (1974) was chosen because it has been proven successful in several previous studies to tropical countries, especially in Malaysia.

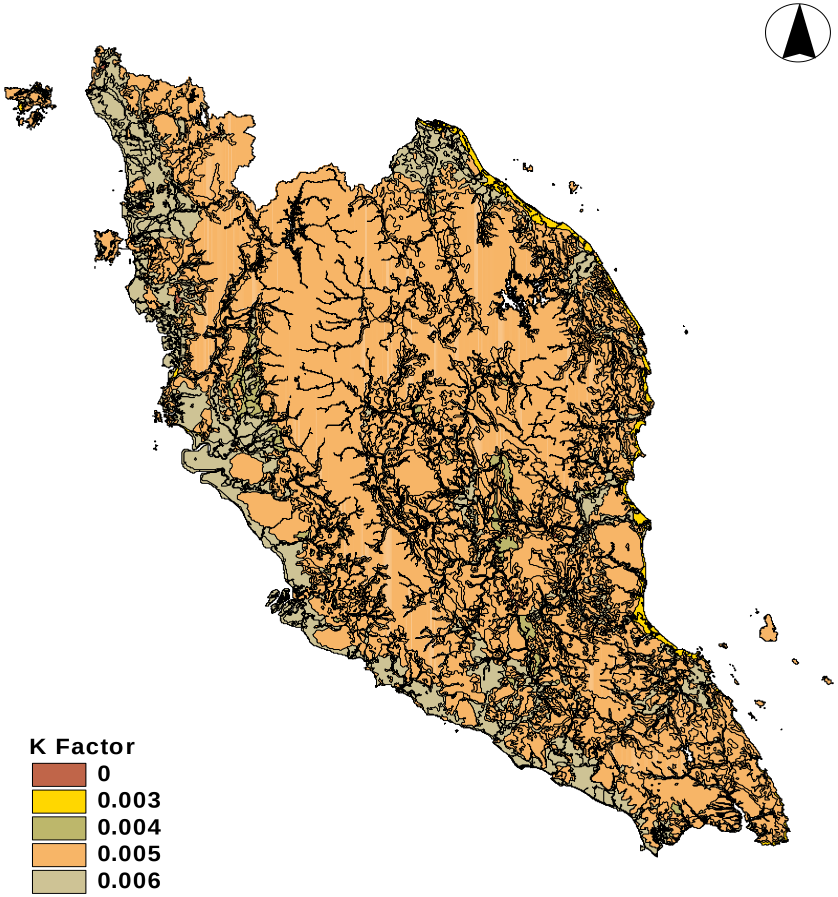
$$R = [(9{:}28 * P) - 8838] * 0.075 \qquad (3)$$

Where,
P = annual average rainfall
I_{30} = rainfall intensity for 30 minutes (75mm)

The rain gauge stations in the study area have been registered into the GIS map format by entering the coordinate position. The average rainfall for each rainfall station will be used as input into the file attributes in the GIS (Figure 2). Based on the input, the estimated rainfall for the Sandakan Town area is done by using the Thiessen polygon method which is a better method than the method of calculation Aritmetrik rainfall areas (Chow et al., 1988).

Issues (4)

- Soil erodibility factor, K in Peninsular Malaysia:



Many attempts have been made to devise a simple index of erodibility based either on the properties of the soil as determined in the laboratory or the field, or on the response of the soil to rainfall (Weischmeier et al. 1971; Weischmeier and Smith, 1978; Tew, 1999; Williams et al., 1984; Shirazi and Boersma, 1984; Singh and Phadke, 2006; Helden, 1987). Of these studies, Tew Equation and Nomograph in Figure 3.13 (Tew, 1999) have been found to give the most satisfactorily estimation of K factor for Malaysia soil series, and are therefore recommended for the calculation of K factor in this guideline.

$$K = \left[1.0x10^{-4}(12 - OM)M^{1.14} + 4.5(s-3) + 8.0(p-2)\right]/100 \qquad (3.8)$$

Where,

K –	Soil Erodability Factor, (ton/ac.)*(100ft.ton.in/ac.hr) For SI unit (ton/ha)(ha.hr/MJ.mm), the conversion factor is 1/7.59.
M -	(% silt + % very fine sand) x (100 - % clay)
OM -	% of organic matter
S -	soil structure code
P -	permeability class

This equation comprises of 5 soil and soil-profile parameters: percent of modified silt (0.002-0.1 mm), percent of modified sand (0.1-2 mm), percent of organic matter (OM), class for soil structure (s) and soil permeability (p). The M value, which represents for silt, very fine sand and clay contents, can be obtained from particle size distribution of the soil by wet or dry sieving analysis in according to BS 1377: Part 2 (1990). The percentage of organic content in the soil can be determined by pre-treatment with hydrogen peroxide by taking the different of weight before and after the pre-treatment. In determination of the soil structure code*s*, the textural triangle as shown in Figure 3.14 which is identical to the Soil Textural Pyramid produces by USGS can be used by drawing horizontal and vertical lines corresponding to the percentage of clay and sand fraction. The value of soil structure code, can be determined from the intersection point of both lines; whereas the permeability code of a soil is a measure of the property which relates to fluid flow through its voids. It can be correlated with grain size distribution or texture of the soil as shown in Table 3.2.

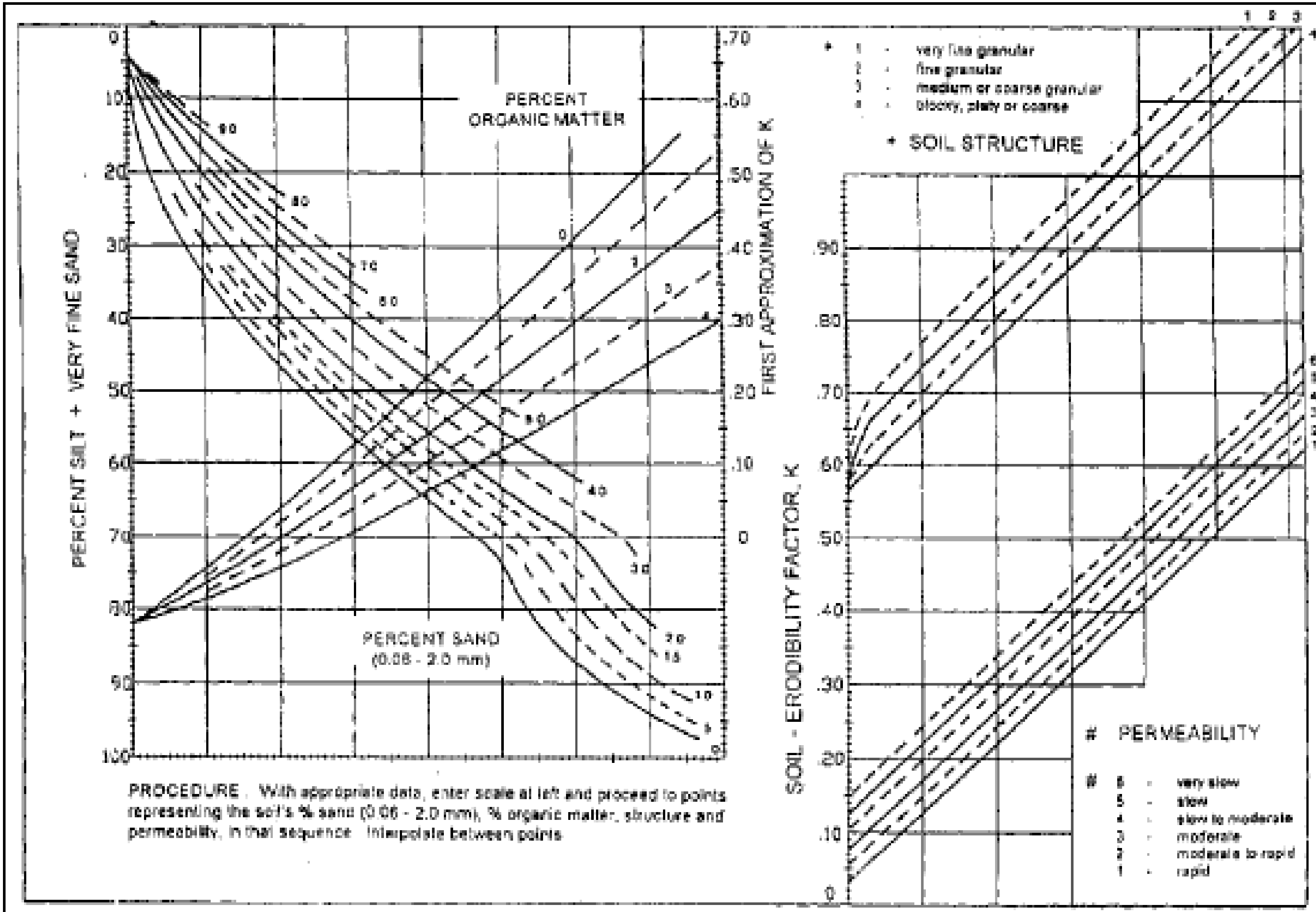


Figure 3.13: Soil erodibility factor, K , (ton/ac.)*(100ft.ton.in/ac.hr) (Tew, 1999) for Malaysia

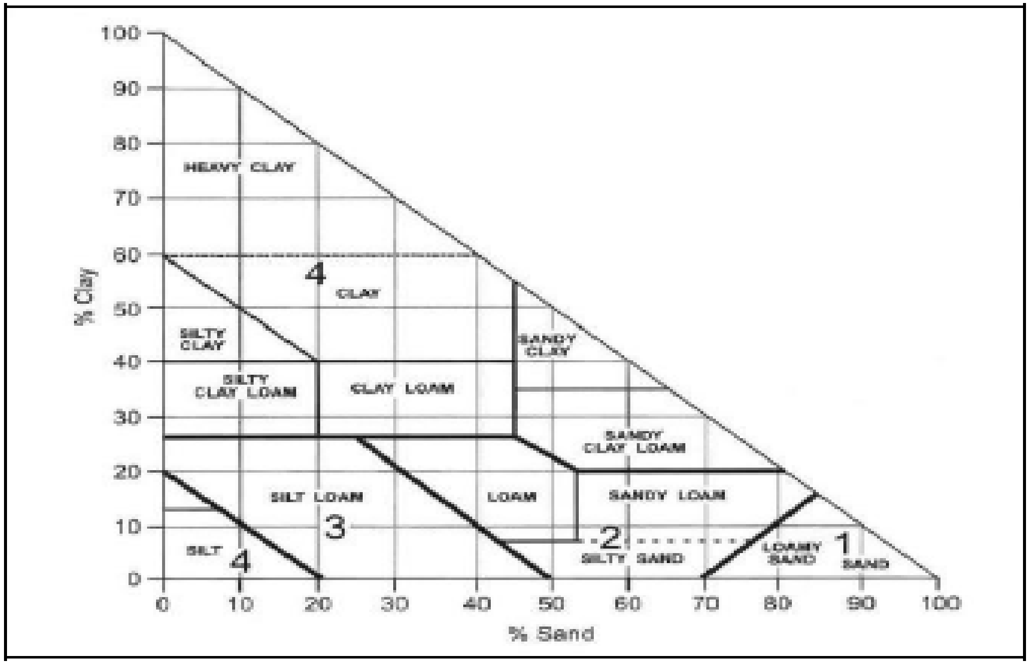


Figure 3.14: Soil Structure Code based on textural classification (Ontario Centre for Soil Resource Evaluation, 1993)

Table 3.2: Soil permeability code based on soil texture class

Soil Texture	Permeability Code[1]	Hydrologic Soil Group[2]
Heavy clay, Clay	6	D
Silty clay loam, Sandy clay	5	C-D
Sandy clay loam, Clay loam	4	C
Loam, Silt loam	3	B
Loamy sand, Sandy loam	2	A
Sand	1	A+

Note: 1 – National Soil Handbook (SCS, 1983)
2 – National Engineering Handbook (SCS, 1972)

Table 3.3: Soil Layer for Soil Series in Malaysia

Texture Layer	Soil Layer Depth (m)
A (Surface soil)	0.00 – 0.50
B (Subsoil)	0.51 – 1.00
C (Substratum)	1.01 – 1.50

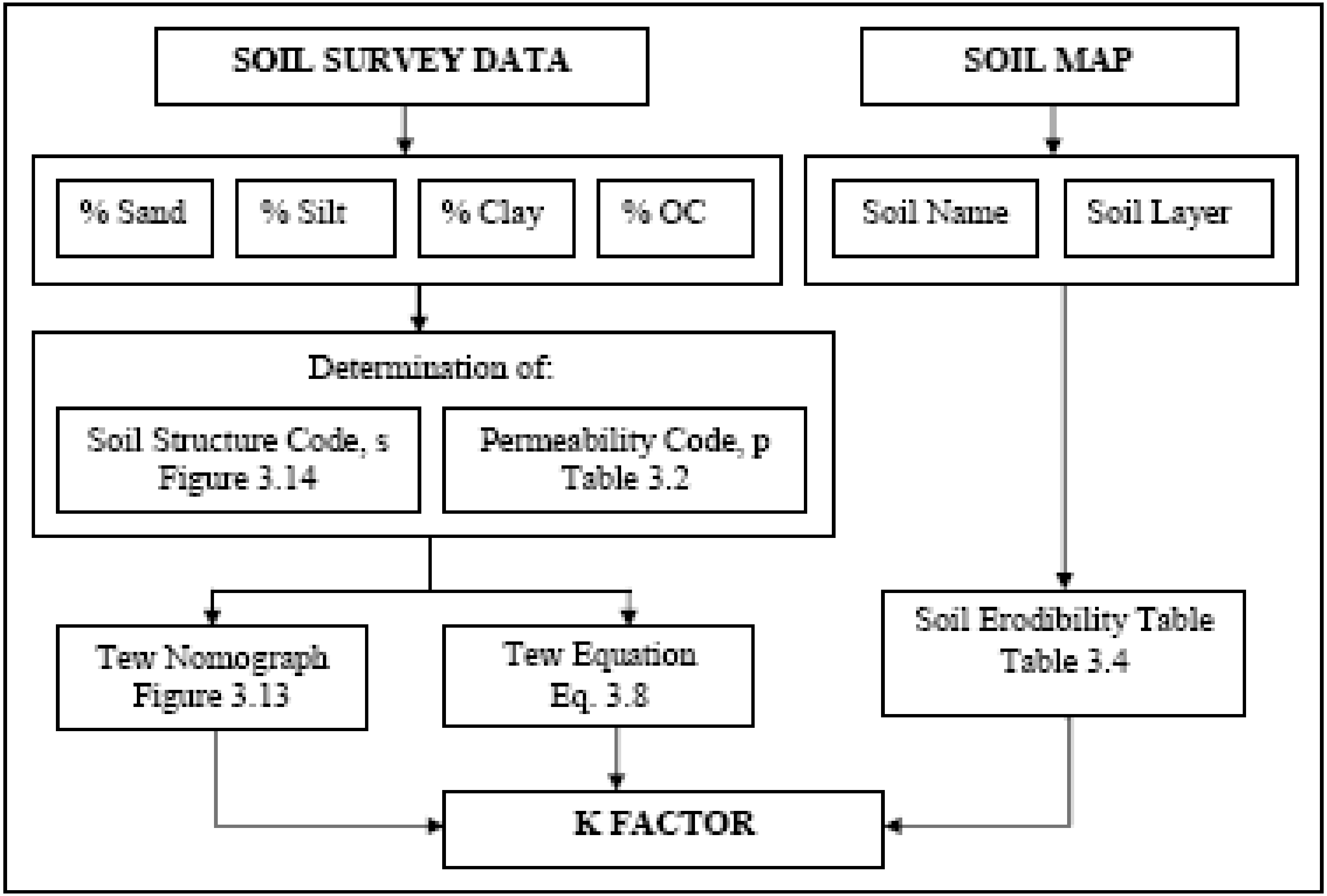


Figure 3.15: Schematic diagrams for determination of K factor

Table 3.4: Soil erodibility factors (K) for Malaysian soil series

Bi	Series	Layer	K Facto (ton/ha)*(hr/MJ.mr	Texture	HSG
1	Akob	A	0.053	clay	D
		B	0.050	clay	D
		C	0.050	clay	D
2	Apek	A	0.045	clay loam	C
		B	0.055	clay loam	C
		C	0.062	clay	D
3	Batu Anam	A	0.056	clay	D
		B	0.057	clay	D
		C	0.051	clay	D
4	Batu Hitam	A	0.060	clay	D
		B	0.063	clay	D
		C	0.063	clay	D
5	Batu lapan	A	0.045	clay loam	C
		B	0.049	clay laom	C
		C	0.060	clay	D
6	Bukit Temiang	A	0.029	sandy clay loam	C
		B	0.038	sandy clay	C-D
		C	0.035	sandy clay loam	C
7	Beriah	A	0.053	clay	D
		B	0.057	clay	D
		C	0.057	clay	D
8	Bungor	A	0.036	sandy clay loam	C
		B	0.053	clay	D
		C	0.054	clay	D
9	Clay Over Organic	A	0.048	clay	D
		B	0.048	clay	D
		C	0.048	clay	D
10	Chat	A	0.048	clay	D
		B	0.048	clay	D
		C	0.048	clay	D
11	Chempaka	A	0.049	clay loam	C
		B	0.049	clay loam	C
		C	0.045	clay loam	C
12	Chengai	A	0.049	clay	D
		B	0.050	clay	D
		C	0.050	clay	D
13	Chenian	A	0.056	clay	D
		B	0.058	clay	D
		C	0.060	clay	D
14	Durian	A	0.053	clay	D
		B	0.051	clay	D
		C	0.051	clay	D
15	Guar	A	0.052	clay	D
		B	0.052	clay	D
		C	0.053	clay	D
16	Halu	A	0.051	sandy clay loam	C
		B	0.058	sandy clay loam	C
		C	0.051	sandy clay loam	C

What's happening in Sabah & Sarawak?

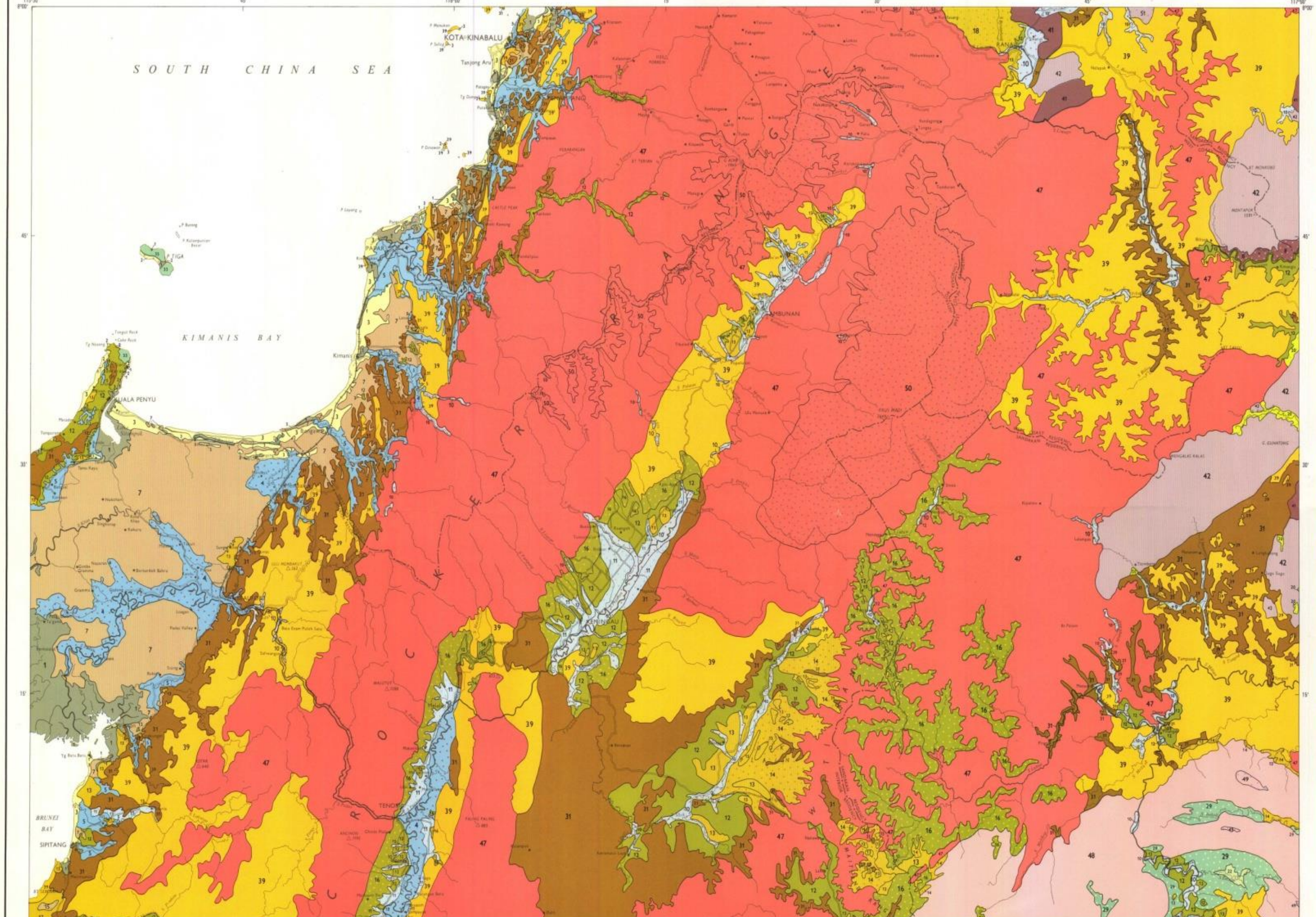
- There are soil maps available (ANCIENT) but no soil erodibility factors for the variable local soil series.
- Level 4 Sanitary Landfill construction site located in Sibu, Sarawak case study :

Due to the absence of empirical value, the K factor of a soil was determined from *USDA Soil Erodibility Nomograph* during pre-construction, construction, and operation stages

MALAYSIA (SABAH) 1:250,000

THE SOILS OF SABAH

SYIT TANAHTANI *SOILS SHEET*	**KOTA KINABALU NB 50-10**



Key	Association	Landform	Parent materials	Main soil units
1	Weston	Tidal swamps	Sulphidic alluvium, sulphidic peat and alluvium	Thionic Fluvisol; Dystric Histosol; Thionic Gleysol
2	Usukan	Beaches	Calcareous alluvium	Calcaric Regosol; Humic Gleysol
3	Tanjong Aru	Beaches	Alluvium	Dystric and Eutric Regosols; Humic, Dystric and Eutric Gleysols; Gleyic Podzol
4	Tuaran	Meander belts	Alluvium	Eutric Fluvisol; Gleyic, Dystric and Eutric Cambisols; Humic, Dystric and Eutric Gleysols
5	Kinabatangan	Floodplains	Alluvium	Gleyic Acrisol; Gleyic Luvisol; Humic, Dystric and Eutric Gleysols
6	Sapi	Swamps	Alluvium and peat	Humic, Dystric and Eutric Gleysols; Dystric Histosol
7	Klias	Swamps	Peat and alluvium	Dystric Histosol; Humic Gleysol
8	Binalik	Valley floors and terraces	Alluvium derived from ultrabasic rocks	Orthic Ferralsol; Gleyic, Ferric and Orthic Luvisols; Ferric and Orthic Acrisols
9	Karamuak	Valley floors and terraces	Alluvium and alluvium derived from basic/ultrabasic rocks	Gleyic, Chromic and Orthic Luvisols; Gleyic and Eutric Cambisols; Eutric Fluvisol
10	Labau	Valley floors and terraces	Alluvium	Gleyic and Dystric Cambisols; Dystric and Eutric Fluvisols; Gleyic and Orthic Acrisols
11	Binkor	Terraces	Alluvium	Dystric and Eutric Gleysols; Gleyic Luvisol
12	Brantian	Terraces	Alluvium	Orthic, Ferric and Gleyic Acrisols; Gleyic Podzol
13	Kapayan	Terraces	Alluvium	Gleyic Podzol; Gleyic Acrisol
14	Sook	Terraces	Alluvium	Gleyic and Orthic Acrisols; Gleyic Podzol; Dystric Gleysol
15	Sipitang	Swamps	Peat and alluvium	Dystric Histosol; Gleyic Podzol
16	Sinarun	Dissected terraces: slopes 15-25°	Alluvium, sandstone and mudstone	Orthic Acrisol; Dystric Gleysol; Dystric Cambisol
17	Tungku	Terraces	Calcareous alluvium	Chromic and Gleyic Luvisols
18	Pinosuk	Plateau with gently undulating surface and dissected terraces with slopes up to 25°	Colluvium, sandstone and mudstone	Gleyic Podzol; Gleyic and Orthic Acrisols; Humic and Dystric Gleysols
19	Tawai	Plateau with gently undulating surface	Ironstone and alluvium derived from ultrabasic rocks	Dystric Histosol; Dystric Gleysol; Dystric Cambisol
20	Tapang	Low hills (slopes 0-15°), terraces and valley floors	Basic igneous rocks and alluvium	Xanthic Ferralsol; Orthic Acrisol; Orthic Luvisol; Eutric Gleysol
21	Semporna	Very low hills: slopes 0-5°	Limestone	Calcic and Chromic Luvisols; Rendzina
22	Lungmanis	Very low hills (slopes 0-15°) and valley floors	Mudstone and alluvium	Gleyic, Ferric and Orthic Acrisols; Gleyic, Ferric, Chromic and Orthic Luvisols
23	Table	Dissected plateaus with flat to gently undulating surfaces	Basic igneous rocks	Xanthic and Orthic Ferralsols
24	Orchid Plateau	Plateau of low hills: slopes 15-25°	Basic and intermediate igneous rocks	Orthic Acrisol; Orthic and Chromic Luvisols
25	Silabukan	Low hills and minor valley floors: slopes 0-15°	Mudstone and alluvium	Gleyic, Ferric and Orthic Acrisols; Gleyic, Ferric, Chromic and Orthic Luvisols
26	Rumidi	Low hills and minor valley floors: slopes 0-15°	Mudstone, sandstone and miscellaneous rocks	Gleyic, Ferric and Orthic Acrisols; Gleyic, Ferric, Chromic and Orthic Luvisols
27	Sipit	Low hills: slopes 0-15°	Mudstone, sandstone and miscellaneous rocks	Ferric and Orthic Acrisols; Orthic Luvisol
28	Apas	Moderate hills: slopes 15-25°	Intermediate and acid igneous rocks	Rhodic Ferralsol; Orthic Acrisol; Eutric Cambisol
29	Kalabakan	Moderate hills: slopes 0-20°	Mudstone and sandstone	Ferric and Orthic Acrisols; Ferric, Chromic and Orthic Luvisols
30	Maming	Moderate hills: slopes >25°	Mudstone and sandstone	Orthic Acrisol; Dystric Cambisol
31	Dalit	Moderate hills and minor valley floors: slopes 0-20°	Sandstone, mudstone and alluvium	Orthic, Ferric and Gleyic Acrisols
32	Tengah Nipah	Moderate hills and minor valley floors: slopes 0-20°	Sandstone, mudstone and alluvium	Ferric, Orthic and Gleyic Acrisols
33	Kretam	Moderate hills: slopes 0-20°	Mudstone, sandstone and miscellaneous rocks	Ferric and Orthic Acrisols; Ferric, Chromic and Orthic Luvisols
34	Bersang	High hills: slopes 15-25°	Basic igneous rocks	Ferric Acrisol; Orthic Luvisol
35	Dagat	Moderate hills: slopes 10-20°	Tuffaceous rocks, mudstone and sandstone	Chromic and Orthic Luvisols; Orthic Acrisol
36	Kennedy Bay	High hills: slopes >25°	Sandstone, mudstone and igneous rocks	Ferric Acrisol; Chromic and Orthic Luvisols; Dystric and Eutric Cambisols
37	Tiger	Very high hills: slopes >25°	Basic igneous rocks	Chromic and Eutric Cambisols
38	Gomantong	Very high hills: slopes >25°	Limestone	Calcic Luvisol; Rendzina
39	Lokan	Very high hills: slopes >25°	Sandstone and mudstone	Orthic Acrisol; Dystric Cambisol
40	Bang	Very high hills: slopes 15-25°	Mudstone, sandstone and miscellaneous rocks	Orthic Acrisol; Dystric Cambisol
41	Bidu Bidu	Mountains and hills	Ultrabasic igneous rocks	Rhodic and Orthic Ferralsols; Eutric Cambisol; Chromic and Orthic Luvisols; Lithosol
42	Mentapok	Mountains	Basic and intermediate igneous rocks	Chromic and Orthic Luvisols; Eutric Cambisol; Lithosol
43	Tinagat	Mountains	Basic and intermediate igneous rocks	Eutric Cambisol; Lithosol; Ferric Luvisol
44	Malubok	Mountains	Igneous rocks, sandstone, mudstone and chert	As for Associations 41, 42 and 47 with Chromic Cambisols and Lithosols on chert
45	Wullersdorf	Mountains	Intermediate and acid igneous rocks	Eutric Cambisol; Lithosol
46	Gumpal	Mountains and hills	Mudstone, sandstone and miscellaneous rocks	Orthic Acrisol; Orthic Luvisol; Dystric and Eutric Cambisols; Lithosol
47	Crocker	Mountains	Sandstone and mudstone	Orthic Acrisol; Chromic and Dystric Cambisols; Lithosol
48	Maliau	Mountain cuestas	Sandstone and mudstone	Orthic Acrisol; Dystric Cambisol; Gleyic Podzol; Humic Gleysol; Lithosol
49	Serudong	Dipslopes of mountain cuestas	Sandstone	Gleyic Podzol; Orthic Acrisol
50	Trusmadi	Mountains above 1 200 m (4 000 ft) a.s.l.	Sandstone and mudstone	Gleyic and Orthic Acrisols; Gleyic Podzol; Humic Gleysol; Dystric Histosol; Lithosol
51	Kinabalu	Mountains above 2 400 m (8 000 ft) a.s.l.	Acid igneous rocks	Humic Cambisol; Dystric Histosol; Lithosol

D.O.S. 3180E

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Published by the British Government's Overseas Development Administration (Land Resources Division) United Kingdom, 1974, for the Sabah Government.

SYIT TANAHTANI *SOILS SHEET*	**KOTA KINABALU NB 50-10**

KAWASAN UKUR TANAHTANI
SOIL SURVEY AREAS

a R.P. BOWER
b M.S. KALSI
c P. THOMAS
d P.A. BURROUGH
e R.P. BOWER
P.A. BURROUGH
f B.D. ACRES
C.J. FOLLAND
g A.D. HOOPER
D.W. IVES
h D.W. McCREDIE
i F. WILSON

Sekil *(Scale)* 1:250,000

Meter *Metres* 5000 0 5 10 15 20 25 30 35 40 Kilometer *Kilometres*

Batu *Miles* 5 4 3 2 1 0 5 10 15 20 Batu *Miles*

UKURAN TINGGI DENGAN UKURAN METER
ELEVATIONS IN METRES

Bandar *Town*	▮	Sempadan Antara Bangsa *International Boundary*	++++++++
Kampung *Village*	•	Sempadan Negeri *State Boundary*	—++—
Jalan *Road*	═	Sempadan Keresidenan *Residency Boundary*	—+—
Stesyen Pengesudutan *Trigonometrical Station*	△		

PETA PANDU SYIT
INDEX TO SHEETS

PETA INI BUKAN-LAH BUKTI YANG SAHIH UNTOK PERENGGANAN SEMPADAN
THIS MAP IS NOT AN AUTHORITY ON BOUNDARIES

Dicetak untuk Directorate of Overseas Surveys oleh Ordnance Survey
Printed for the Directorate of Overseas Surveys by the Ordnance Survey.
74741736 1

Peta asas didapatkan dari punca-punca terbaik yang ada, dengan pindaan terhad oleh Pasukan Rancangan L.R.D.
Maklumat pakar disusun dari penyelidikan luar, dan tafsiran foto udara yang berkaitan seperti yang ditunjukkan di gambarajah "Kawasan Ukur Tanahtani."
Peta ini berlampiran dengan Kajian Sumber Tanah 'The Soils of Sabah' diterbitkan oleh Land Resources Division, Overseas Development Administration, Tolworth Tower, Surbiton, Surrey, England, KT6 7DY.

Base map derived from best available sources, with limited revision by L.R.D. Project Team.
Specialist information compiled from field investigation, and related air photo interpretation, as indicated in the 'Soil Survey Areas' diagram.
This map accompanies a Land Resources Study 'The Soils of Sabah,' published by the Land Resources Division, Overseas Development Administration, Tolworth Tower, Surbiton, Surrey, England, KT6 7DY.

SHEET A

SOIL MAP OF SARAWAK

MALAYSIA TIMOR

1968

SCALE 1:500,000 or 7.89 MILES TO AN INCH

Miles 10 5 0 10 20 30 40 50 Miles

MAP PROJECTION: RECTIFIED SKEW ORTHOMORPHIC

KEY

Mainly **SKELETAL SOILS:** very shallow sands to clays, overlying weathered rock at less than 25 cms. depth; parent rock varied but mainly sedimentary; on steep or mountainous land. (Equiv: Lithosols)

Mainly **SKELETAL SOILS** and **BROWN FOREST SOILS:** bare hard limestone, thin humus pockets over bare rock, and shallow brown clays; confined to karst topography. (Equiv: Lithosols, Rendzinas)

Mainly **SKELETAL SOILS** and **LATERITIC SOILS:** shallow to moderately deep, yellow to red clays; on basic to intermediate igneous rocks; steep and moderately steep land. (Equiv: Lithosols, Acrisols, Oxisols)

Mainly **SKELETAL SOILS** and **RED-YELLOW PODZOLIC SOILS:** very shallow to moderately deep loamy sands to clays; on sedimentary, acid igneous and metamorphic rocks; steep and mountainous land. (Equiv: Lithosols, Acrisols)

Mainly **RED-YELLOW PODZOLIC SOILS:** shallow to deep, yellow to red loamy sands to clays; on sedimentary, acid igneous and metamorphic rocks; gently sloping to steep land. (Equiv: Acrisols, Ferralsols)

Mainly **GREY-WHITE PODZOLIC SOILS:** moderately deep to deep, white, grey or pale yellow loamy sands to clays; on sedimentary rocks or old alluvium; flat to moderately steep land. (Equiv: Acrisols, Ferralsols, Planosols)

Mainly **PODZOLS:** shallow to deep, pale-coloured sands with prominent sub-surface accumulation of humus or, locally, iron; on old or subrecent alluvium or coarse-textured sedimentary rocks; flat to gently sloping land. (Equiv: Podzols)

Mainly **GLEY SOILS:** poorly-drained sands to clays; on recent alluvium in floodplain areas; on old alluvium on low-level terraces; on sedimentary rocks on gently undulating land and some dip slopes. (Equiv: Gleysols)

Mainly **SALINE GLEY SOILS:** poorly-drained clays; on recent alluvium; mainly confined to deltaic areas subject to brackish water flooding. (Equiv: Gleysols)

Mainly shallow **PEAT SOILS** (overlying mineral material at less than 1 metre depth); mainly in present floodplains; locally at high altitude in mountainous land. (Equiv: Histosols)

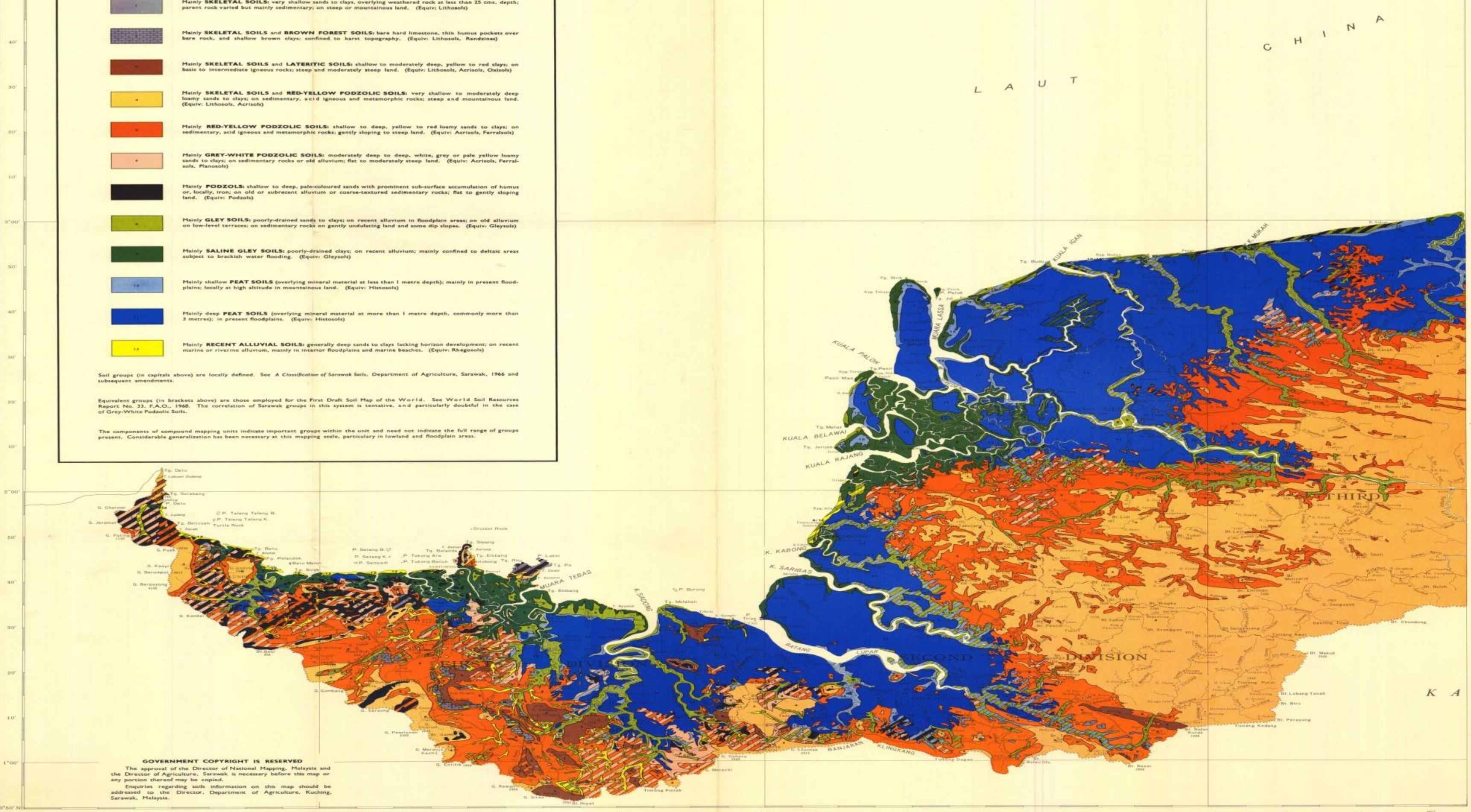
Mainly deep **PEAT SOILS** (overlying mineral material at more than 1 metre depth, commonly more than 3 metres); in present floodplains. (Equiv: Histosols)

Mainly **RECENT ALLUVIAL SOILS:** generally deep sands to clays lacking horizon development; on recent marine or riverine alluvium, mainly in interior floodplains and marine beaches. (Equiv: Rhegosols)

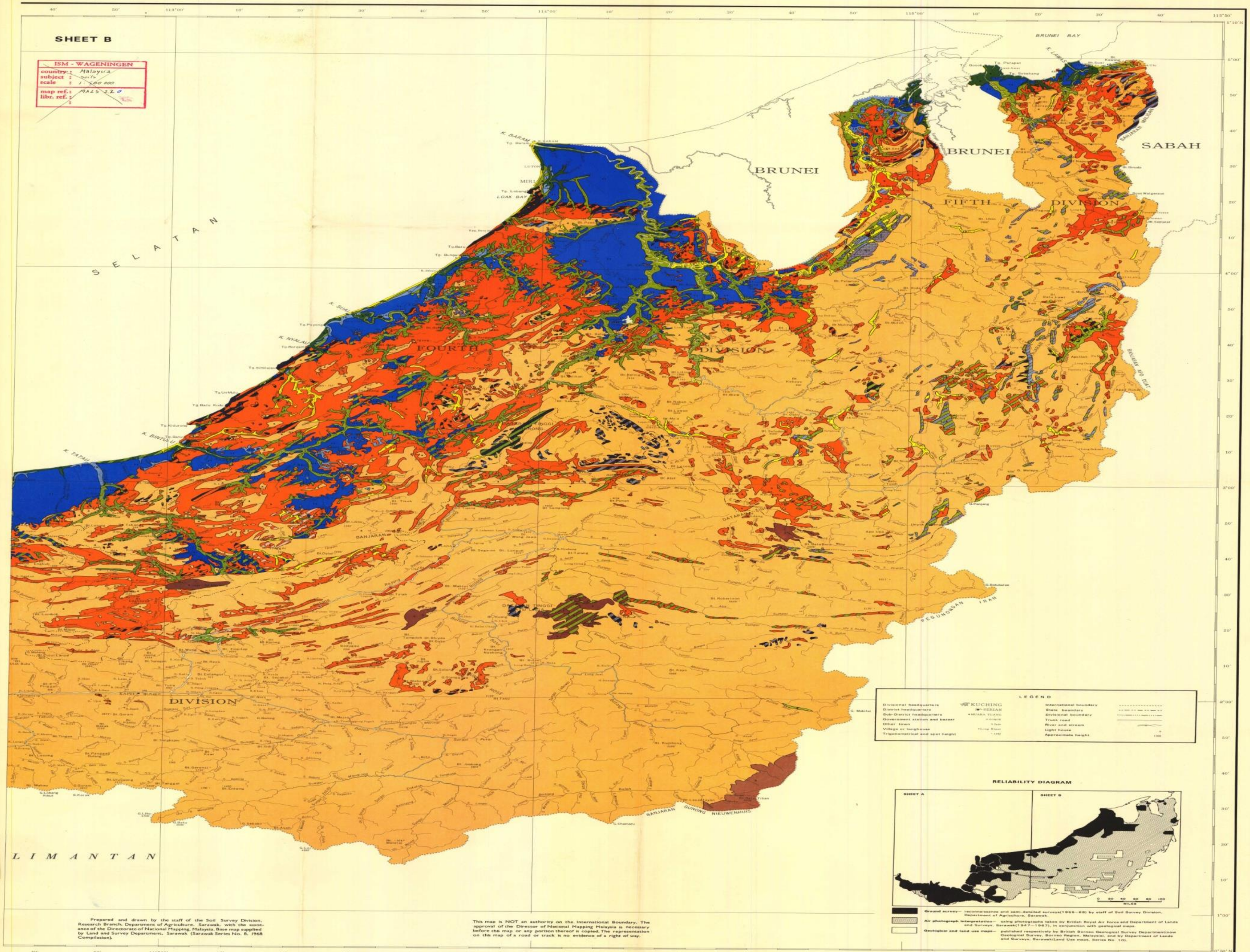
Soil groups (in capitals above) are locally defined. See *A Classification of Sarawak Soils*, Department of Agriculture, Sarawak, 1966 and subsequent amendments.

Equivalent groups (in brackets above) are those employed for the First Draft Soil Map of the World. See World Soil Resources Report No. 33, F.A.O., 1968. The correlation of Sarawak groups in this system is tentative, and particularly doubtful in the case of Grey-White Podzolic Soils.

The components of compound mapping units indicate important groups within the unit and need not indicate the full range of groups present. Considerable generalization has been necessary at this mapping scale, particulary in lowland and floodplain areas.



Enquiries regarding soils information on this map should be addressed to the Director, Department of Agriculture, Kuching, Sarawak, Malaysia.



Directorate of National Mapping, Malaysia. No. 38-1969
Printed in 1970

Issues (5)

- Slope length and steepness factor, LS

The LS factor can be calculated using methodology suggested in Chapter 15, MSMA (DID, 2000), which applied the equation defined by Wischmeier (1975);

$$LS = (\lambda / \Psi)^{m} \times (0.065 + 0.046s + 0.0065s^{2})$$

Where, λ = sheet flow path length (m or feet)
Ψ = 22.13 for SI Units and 72.6 for English Units (BU)
s = average slope gradient (%)
m = 0.2 for $s < 1$,
= 0.3 for $1 \leq s < 3$,
= 0.4 for $3 \leq s < 5$,
= 0.5 for $5 \leq s < 12$ and
= 0.6 for $s \geq 12\%$

The values obtained using different slope length and slope steepness is tabulated in Table 3.5 for practical application.

Table 3.5: Slope Length and Steepness Factor (LS)

Slope Steepness, s (%)	Slope Length, λ (m)											
	2	5	10	15	25	50	75	100	150	200	250	300
0.1	0.043	0.052	0.059	0.064	0.071	0.082	0.089	0.094	0.102	0.108	0.113	0.117
0.5	0.055	0.067	0.076	0.083	0.092	0.106	0.114	0.121	0.131	0.139	0.146	0.151
1	0.057	0.075	0.093	0.405	0.122	0.150	0.170	0.185	0.209	0.228	0.243	0.257
2	0.089	0.117	0.144	0.163	0.190	0.234	0.264	0.288	0.325	0.354	0.379	0.400
3	0.100	0.144	0.190	0.224	0.275	0.362	0.426	0.478	0.563	0.631	0.690	0.742
4	0.135	0.195	0.257	0.302	0.371	0.489	0.575	0.646	0.759	0.852	0.932	1.002
5	0.138	0.218	0.308	0.377	0.487	0.688	0.843	0.973	1.192	1.376	1.539	1.686
6	0.173	0.273	0.387	0.474	0.612	0.865	1.059	1.223	1.498	1.730	1.934	2.119
8	0.255	0.404	0.571	0.699	0.903	1.277	1.564	1.806	2.212	2.554	2.855	3.128
10	0.353	0.559	0.790	0.968	1.250	1.767	2.165	2.499	3.061	3.535	3.952	4.329
15	0.525	0.909	1.378	1.757	2.388	3.619	4.616	5.486	6.997	8.315	9.506	10.605
20	0.848	1.470	2.228	2.841	3.860	5.851	7.463	8.869	11.311	13.442	15.368	17.145
25	1.249	2.164	3.279	4.183	5.683	8.613	10.986	13.055	16.651	19.788	22.623	25.239
30	1.726	2.991	4.533	5.782	7.855	11.906	15.185	18.046	23.017	27.353	31.272	34.887
40	2.911	5.045	7.646	9.752	13.250	20.083	25.614	30.440	38.824	46.139	52.749	58.846
50	4.404	7.631	11.567	14.753	20.044	30.382	38.749	46.050	58.733	69.798	79.798	89.023
60	6.204	10.751	16.296	20.784	28.239	42.802	54.590	64.875	82.744	98.333	112.420	125.416
70	8.312	14.404	21.833	27.846	37.833	57.344	73.138	86.917	110.856	131.741	150.615	168.026
80	10.728	18.590	28.177	35.938	48.827	74.008	94.391	112.174	143.070	170.025	194.383	216.854
90	13.451	23.309	35.329	45.060	61.221	92.793	118.350	140.648	179.386	213.182	243.723	271.898
100	16.482	28.560	43.289	55.212	75.014	113.700	146.016	172.337	219.803	261.214	298.637	333.159

Issues (6)

- Crop management, C factor and Erosion control Practice, P factor.
- Values of commonly found C related to Malaysian conditions are provided in Tables 3.6 to 3.8.
- P values for common support practices found in Malaysia in given in Table 3.9.
- It should be noted that the C and P factors being suggested are of typical values under average runoff condition, and therefore, it should be used with extra caution for other surface and runoff conditions.

Table 3.6: Cover Management, C factor for forested and undisturbed lands[1] (modified from: Layfield, 2009; Troeh et al., 1999; Mitchell and Bubenzer, 1980; ECTC, 2003; Ayad, 2003)

Erosion control treatment	**C Factor**
Rangeland	0.23
Forest/Tree	
25% cover	0.42
50% cover	0.39
75% cover	0.36
100% cover	0.03
Bushes/ Scrub	
25% cover	0.40
50% cover	0.35
75% cover	0.30
100% cover	0.03
Grassland (100% coverage)	0.03
Swamps/ mangrove	0.01
Water body	0.01

Note: 1 - average runoff condition

Table 3.7: Cover Management, C factor for agricultural and urbanized areas[1] (modified from: Layfield, 2009; Troeh et al., 1999)

Erosion control treatment	**C Factor**
Mining areas	1.00
Agriculturel areas	
Agricultural crop	0.38
Horticulture	0.25
Cocoa	0.20
Coconut	0.20
Oil palm	0.20
Rubber	0.20
Paddy (with water)	0.01
Urbanized areas	
Residential	
Low density (50% green area)	0.25
Medium density (25% green area)	0.15
High density (5% green area)	0.05
Commercial, Educational and Industrial	
Low density (50% green area)	0.25
Medium density (25% green area)	0.15
High density (5 green area)	0.05
Impervious (Parking lot, road, etc.)	0.01

Note: 1 - average runoff condition

Table 3.8: Cover Management, C factor for BMPs at construction sites[1] (modified from: Layfield, 2009; Troeh et al., 1999; Mitchell and Bubenzer, 1980; ECTC, 2003; Israelsen et al. 1980; HDI, 1987; SCS, 1986; Weischmeier and Smith, 1978; Kuenstler, 2009;)

Erosion control treatment	C Factor
Bare soil / Newly cleared land	1.00
Cut and fill at construction site	
Fill Packed, smooth	1.00
Freshly disked	0.95
Rough (offset disk)	0.85
Cut Below root zone	0.80
Mulch	
plant fibers, stockpiled native materials/chipped	
50% cover	0.25
75% cover	0.13
100% cover	0.02
Grass-seeding and sod	
40% cover	0.10
60% cover	0.05
≥90% cover	0.02
Turfing	
40% cover	0.10
60% cover	0.05
≥90% cover	0.02
Compacted gravel layer	0.05
Geo-cell	0.05
Rolled Erosion Control Product:	
Erosion control blankets / Turf reinforcement mats	0.02
Plastic sheeting	0.02
Turf reinforcement mats	0.02

Note: 1 - average runoff condition

Table 3.9: Support Practice, P factor for BMPs at construction/ developing sites[1] (modified from: Layfield, 2009; Troeh et al., 1998; Mitchell and Bubenzer, 1980; ECTC, 2003; Israelsen et al. 1980; HDI, 1987; SCS, 1986; Weischmeier and Smith, 1978; Kuenstler, 2009)

Support/ Sediment Control Practice	P Factor
Bare soil	1.00
Disked bare soil (rough or irregular surface)	0.90
Wired log / Sand bag barriers	0.85
Check Dam	0.80
Grass buffer strips (to filter sediment laden sheet flow)	
Basin slope (%)	
0 to 10	0.60
11 to 24	0.80
Contour furrowed surface (maximum length refers to downslope length)	
Slope (%) Max. length	
1 to 2 120	0.60
3 to 5 90	0.50
6 to 8 60	0.50
9 to 12 40	0.60
13 to 16 25	0.70
17 to 20 20	0.80
> 20 15	0.80
Silt fence	0.55
Sediment containment systems (Sediment basin/Trap)	0.50
Berm drain and Cascade	0.50
Terracing	
Slope (%)	
1 to 2	0.12
3 to 8	0.10
9 to 12	0.12
13 to 16	0.14
17 to 20	0.16
> 20	0.18

Note: 1 - average runoff condition

Issues (7)

- For runoff estimation, the Curve Number method, CN developed by US National Resources Conservation Services (NRCS) is widely used.
- Initially developed primarily for agricultural land use, although it has been extended to other land-use types.
- The surface runoff volume, V can then be calculated by multiplying the runoff depth with the area involved.

Table 3.10: CN values factor for forested and undisturb lands[1] (modified from: Shamshad et al., 2008; SCS, 1986; Leow et al, 2009; Seeni Mohd & Mohd Adli, 2000)

Ground Conditions	**CN value**			
	A	**B**	**C**	**D**
Rangeland	59	74	82	86
Forest[2]				
Poor	45	66	77	83
Fair	36	60	73	79
Good	30	55	70	77
Bushes				
<50% cover	54	72	81	86
50 to 75% cover	63	77	85	88
>75% cover	55	66	80	87
Grassland				
< 50% cover	68	79	86	89
50 to 75 % cover	49	69	79	84
>75% cover	39	61	74	80
Swamps/ mangrove	77	80	83	86
Water body	100	100	100	100

Note: 1- Average runoff condition
2 - Poor - small trees, brush are destroyed by having grazing or regular burning.
Fair - woods are grazed but not burn, some forest litter cover the soil.
Good- woods are protected from grazing, litter and brush adequately cover the soil.

Table 3.11: CN factor for agricultural and urbanized areas[1] (modified from: Shamshad et al., 2008; Leow et al., 2009; Fifield, 2004)

Ground Conditions	**CN values**			
	A	**B**	**C**	**D**
Rubber	64	74	81	85
Oil palm	50	66	80	87
Cocoa	64	74	81	85
Coconut	71	80	87	90
Horticulture	62	70	78	81
Paddy	64	75	83	86
Mining areas	68	79	86	89
Bare land/ Newly Graded land	71	86	91	94
Impervious (Pavement, Roof etc)	98	98	98	98
Established Urban Areas: (including Residential, Commercial, Educational and Industrial)				
Low density (50% green area)	57	72	81	86
Medium density (25% green area)	77	85	90	92
High density (5% green area)	89	92	94	95

Note: 1- Average runoff condition

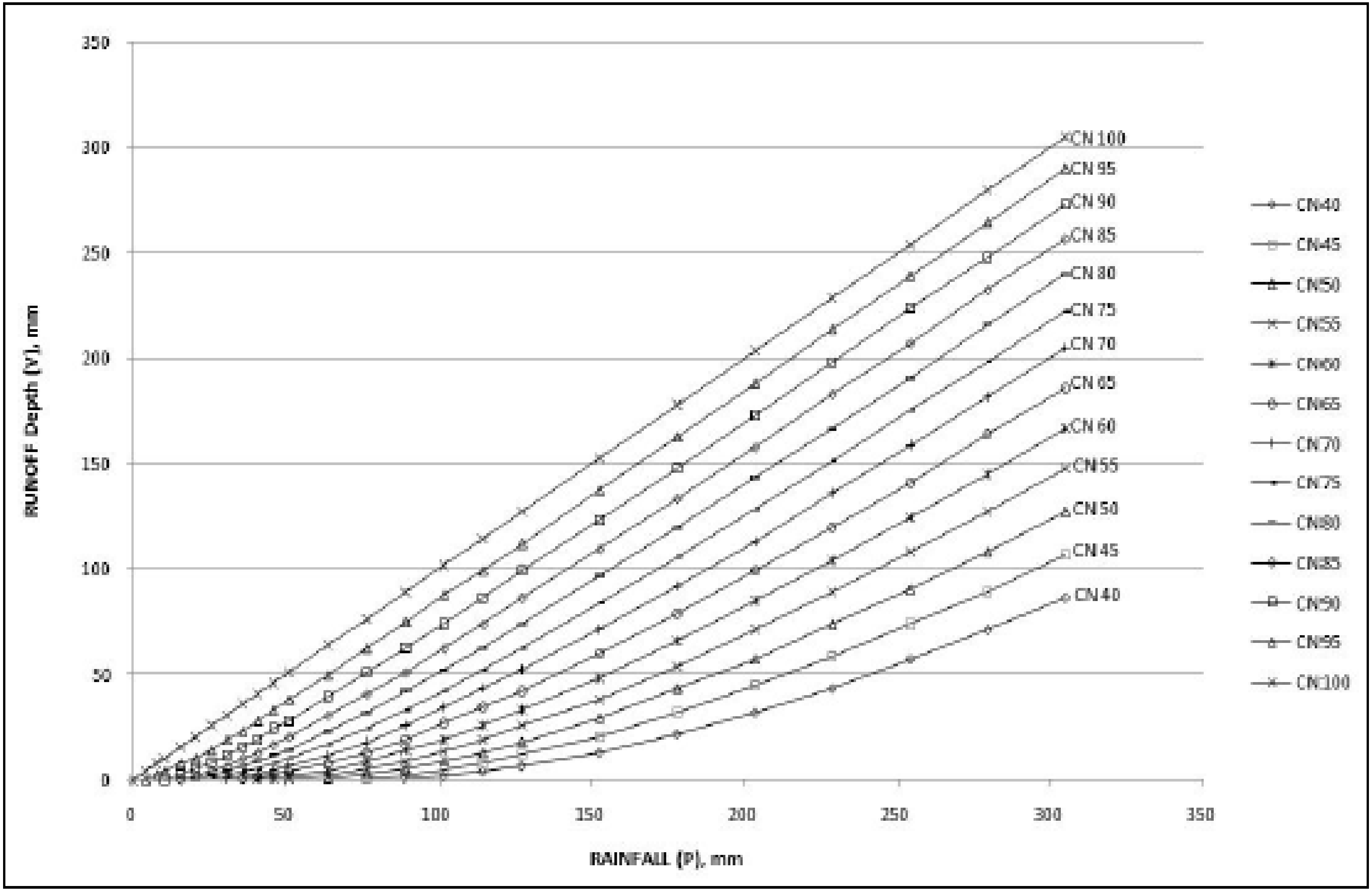


Figure 3.17: SCS Rainfall - Runoff Chart

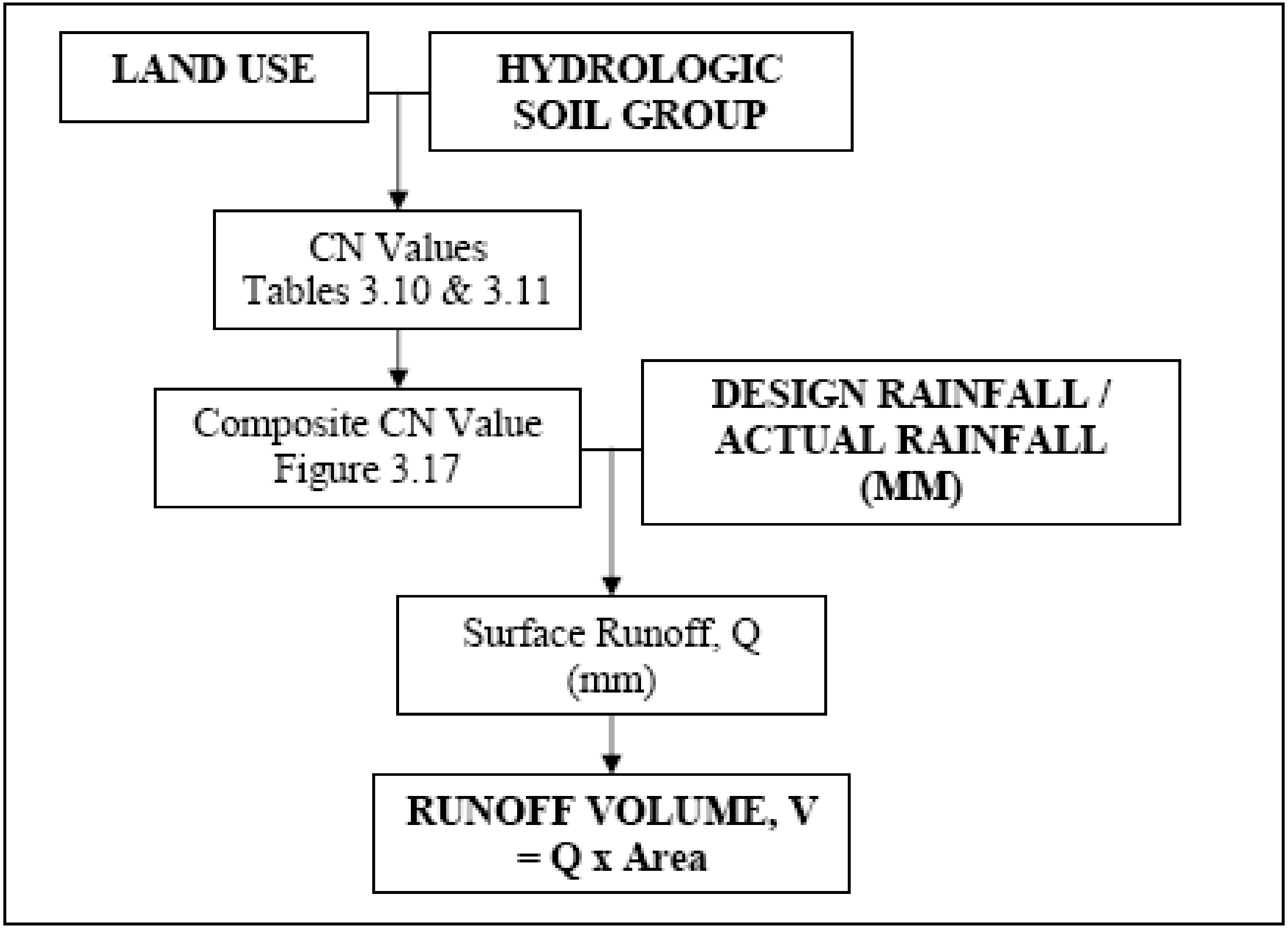


Figure 3.18: Schematic Diagram for determination of runoff volume

Issues (8)

- Peak discharge, Qp - MSMA recommended the Rational Method (for small catchment only) and Time Area Method for peak discharge estimation in Malaysia.

USLE/RUSLE/MUSLE CALCULATION:

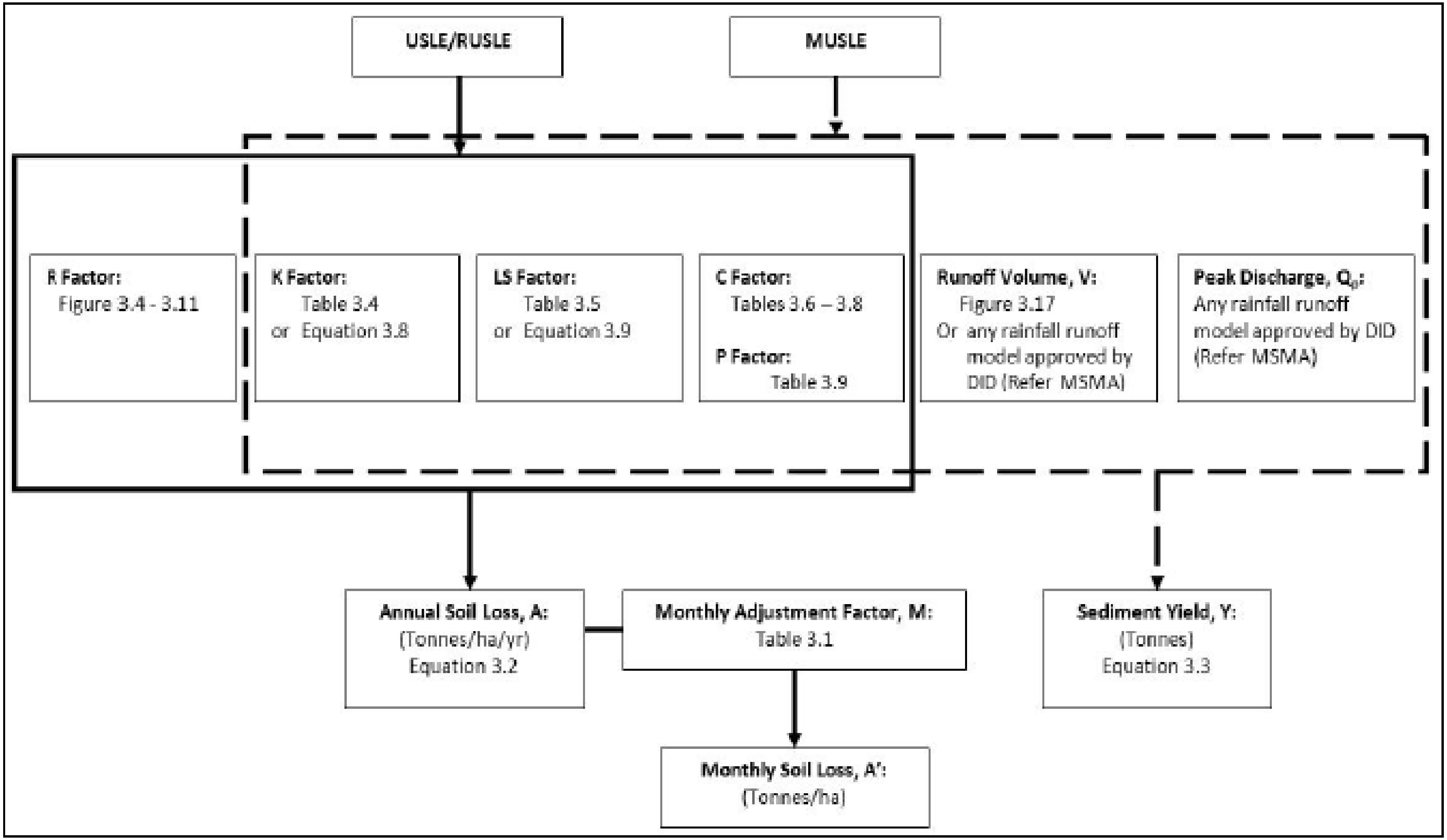


Figure 3.19: Schematic Diagram for determination of Soil loss and sediment yield

In summary,

- It could and would be a daunting task for engineers and others ESC practitioners in Sabah & Sarawak involved in smaller-scale projects to prepare their plans without the help of a basic guideline, with many predetermined values.
- The unavailability of such guideline could impact best management practices at construction/agricultural sites etc, resulting to unnecessary soil loss and sediment yield which could deteriorate surrounding environment, especially water resources.


DON'T
BLOW IT,
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Ministry of Natural Resources and Environment
Jalan Sultan Salahuddin
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GUIDELINE FOR EROSION AND SEDIMENT CONTROL IN MALAYSIA

Ministry of Natural Resources and Environment
Malaysia

GUIDELINE FOR EROSION AND SEDIMENT CONTROL IN MALAYSIA

Department of Irrigation and Drainage
Malaysia

Chapter 1: INTRODUCTION

1.0 Background.

1.1 Local experience with construction sites.

1.2 Necessity of the guideline.

1.3 Objective of the guideline.

1.4 Usage of the guideline.

Chapter 2: RULES & REGULATIONS

2.1 Introduction.

2.2 Federal and state regulations.

a. The Federal Constitution of Malaysian.
b. Government policies.
c. Environmental quality and control.
d. Land.
e. Forestry.
f. Mining.
g. Quarries.
h. River and streams.
i. Town planning.
j. Fisheries.

2.3 Enforcement and penalties.

Chapter 3: SOIL EROSION & SEDIMENTATION

3.1 Soil erosion and sedimentation processes.

a. Rainsplash erosion.
b. Sheet erosion.
c. Rill erosion.
d. Gully erosion.
e. Riverbank erosion.
f. Tunnel erosion.
g. Wind erosion.

3.2 Soil loss and sediment yield estimation.

a. USLE
b. MUSLE

3.3 Soil loss and sediment yield parameters.

a. Rainfall erosivity factor, R
b. Soil erodibility factor, K
c. Slope length and steepness factor, LS
d. Cover management and erosion control practice factors, C and P.
e. Curve number, CN and surface runoff, V
f. Peak discharge, Q_p

3.4 Summary

Chapter 4: EROSION & SEDIMENT CONTROL PLAN

4.1 Introduction.

4.2 Submission requirements for construction activity.

a. Who should obtain approval?
b. Deadlines
c. Compliance with other plans.
d. Minimum requirements of ESCP.

4.3 Generic guidelines for ESCP.

a. Minimizing soil erosion.
b. Preserving top soil and other assets.
c. Access routes and site managements.
d. Drainage control and runoff management.
e. Earthwork and erosion control.
f. Sediment prevention and control.
g. Slope stabilization
h. Site maintenance.

4.4 Plan preparation stages.

4.5 Inspection and maintenance.

4.6 Content of ESCP.

Chapter 5: EROSION & SEDIMENT CONTROL FACILITIES

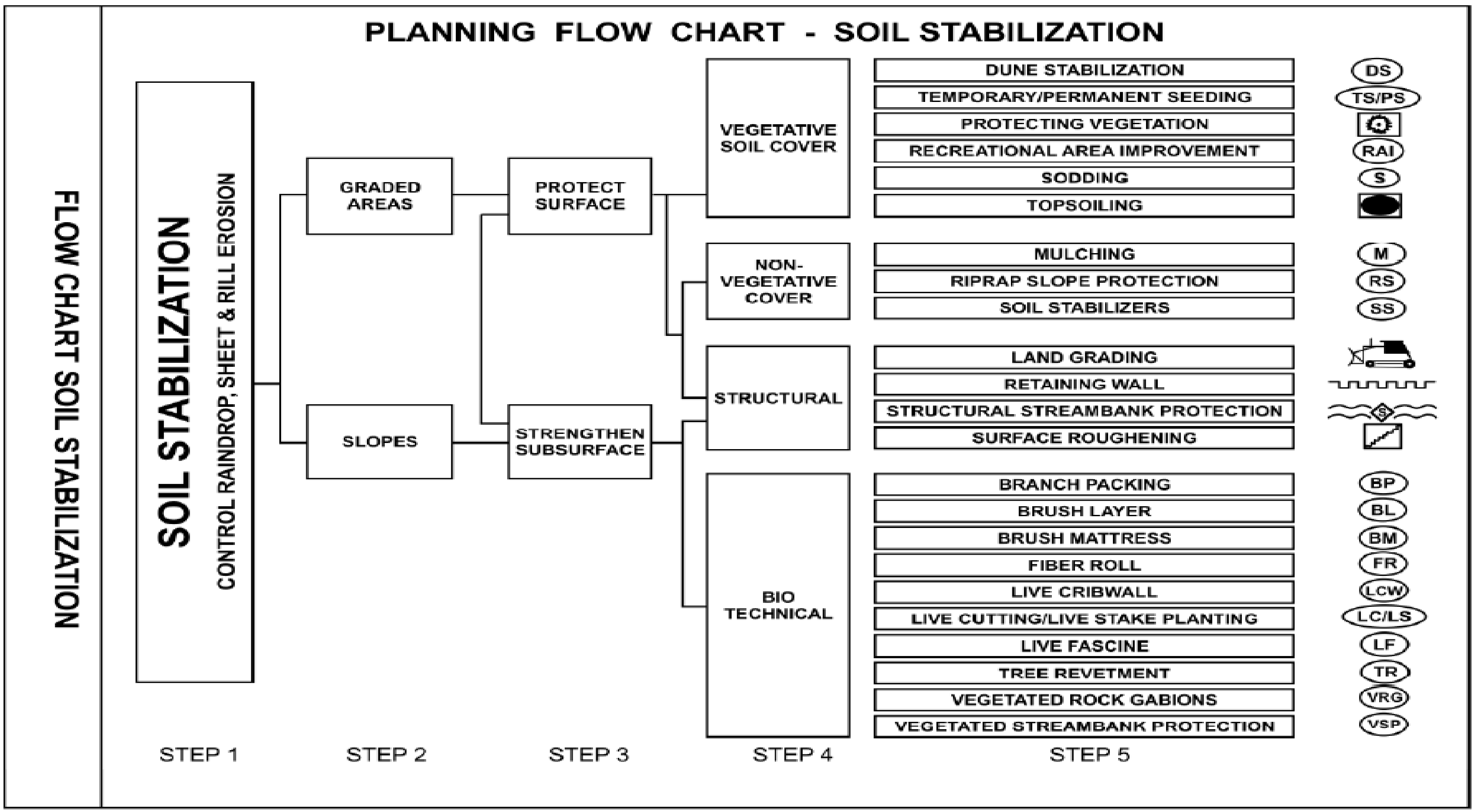
5.1 Introduction.

For best management practice at the site during earthwork, an effective erosion and sediment control is done through three lines of defense:

1. Soil stabilization and revegetation
2. Runoff control and diversion
3. Sediment basin

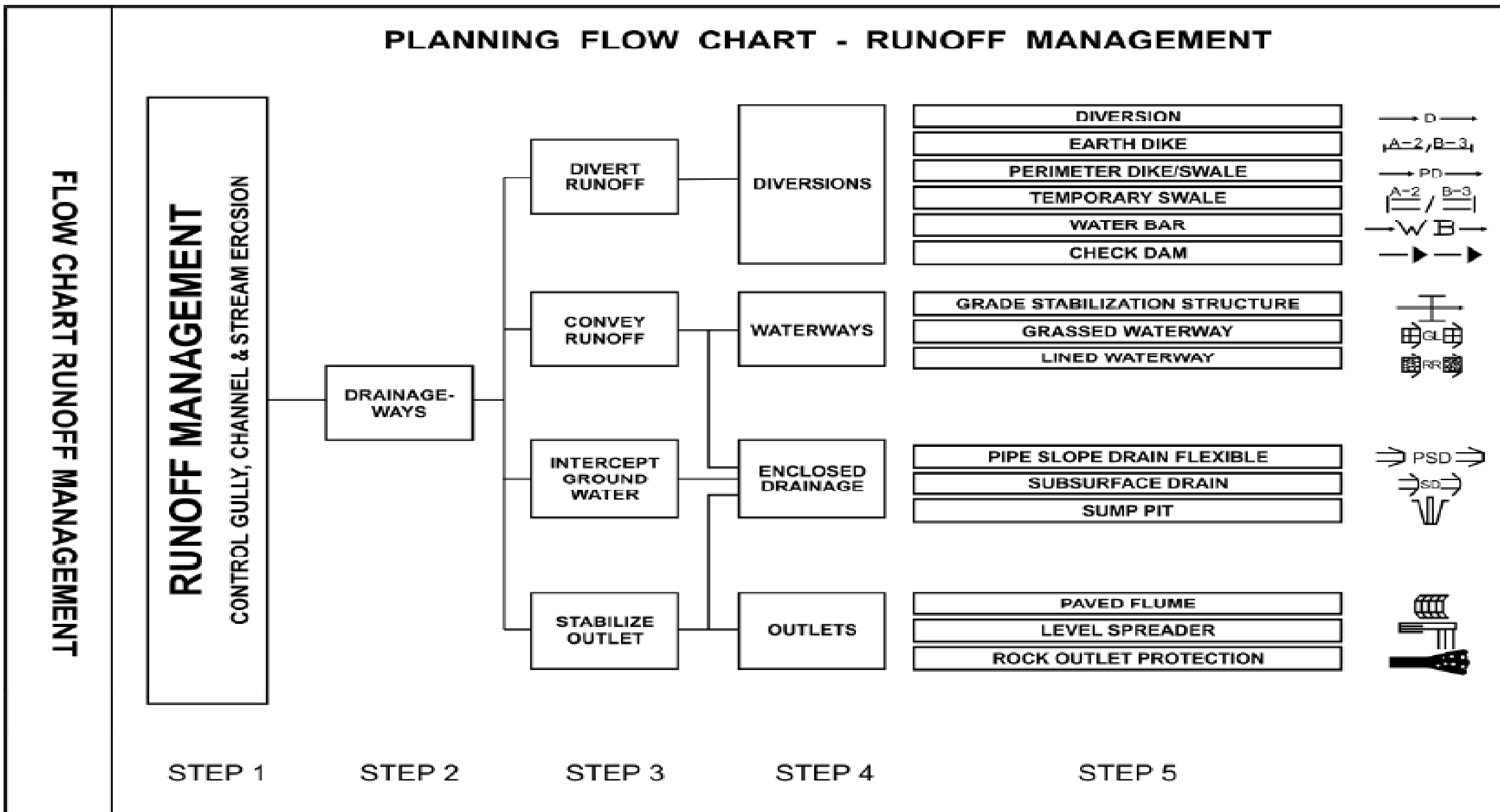
Chapter 5: EROSION & SEDIMENT CONTROL FACILITIES

5.2 Erosion control facilities.



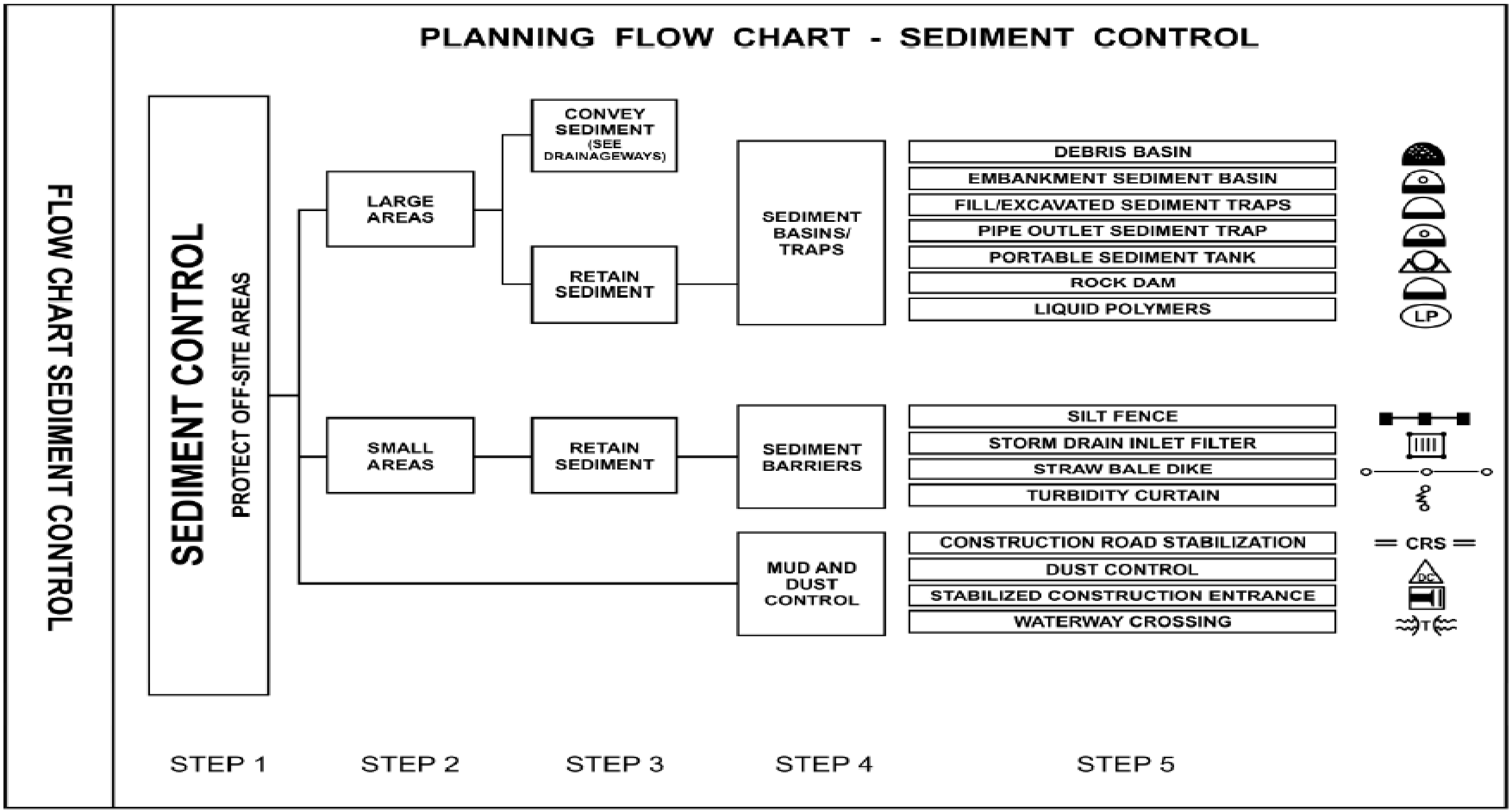
Chapter 5: EROSION & SEDIMENT CONTROL FACILITIES

5.3 Runoff management facilities.

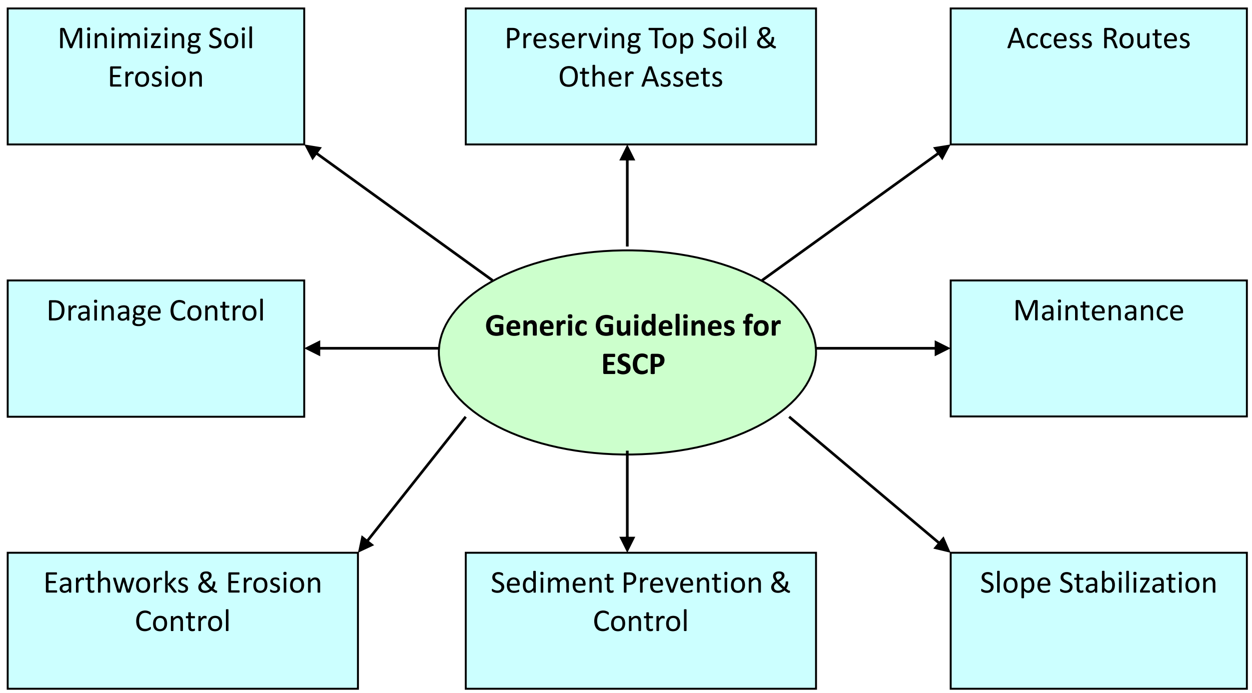


Chapter 5: EROSION & SEDIMENT CONTROL FACILITIES

5.4 Sediment control facilities.



Generic Guideline for ESCP




ALONE WE CAN DO SO LITTLE; TOGETHER WE CAN DO SO MUCH.
- HELEN KELLER
STRONGER
TOGETHER

THE WAY FORWARD

- A consultant company may bid for funding through State or JPS Federal (BSMA) to produce the manual.

Consultant
USAINS HOLDING SDN BHD
River Engineering and Urban Drainage Research Centre (REDAC)
Engineering Campus , Universiti Sains Malaysia
Seri Ampangan, 14300 Nibong Tebal, Pulau Pinang, Malaysia

- MSO could provide the interested parties with its own version of ‘Terms of References’ – contact Dato Fuad/me(IR Azman).

TABLE OF CONTENTS

The Scope of Service shall comprise but not be limited to the following:

i. Review existing US methodology as laid out in the CPESC (Certified Professional in Erosion and Sediment Control) manual

ii. Rainfall, Soil and Landuse data collection and collation

iii. Production of Isoerodent ie. Erosivity map for Malaysia

iv. Production of Slope Length, Erodibility, P factor (Management practice) and C factor (Crop cover) tables

v. Production of Hydrologic Soil Group tables, Runoff Curve Number tables for various categories of landuse, and Runoff Curve Number graph

vi. Production of Soil Erodibility tables for various soil textures and layers, and Soil Erodibility Nomograph

vii. Incorporation of worked examples and photographs to illustrate estimates

viii. Incorporation of the use of BMPs to control earthworks in typical Erosion and Sediment Plans (ESCP)

ix. Producing relevant isopleths using GIS for further modeling application

x. Hands-on training for JPS staff

6. CONSULTANT'S QUALIFICATION

The consulting firm shall provide suitably experienced personnel such as hydrologist and soil specialist to undertake the Services. A qualified CPESC would be an asset.

7. FEES AND DURATION OF THE CONSULTING ENGINEER

The Consulting Service shall commence within one month of the issue of notice to proceed.

Based on the scope of the Service, the Services are expected to take 12 months to complete.

Fees to the Consultant shall be made in accordance with standard Treasury procedures on Government consultancies.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