THE EFFECT OF TYPES OF VEGETATION ON SLOPE ALONG THE NORTH-SOUTH EXPRESSWAY

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By,

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DISSERTATION

Submitted to the Civil Engineering Programme
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CERTIFICATION OF APPROVAL

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NAZIFA BINTI MOHD ASRI

ABSTRACT

North-South Expressway is an infrastructure network constructed to link North area and South area in Peninsular Malaysia. The expressway involves of many cut-off slopes during its construction. The disturbance slope will change its stability that lead to slope failure such as erosion and landslide. The main objective of this study is to investigate, determine and analyze the effect of types of vegetation on slopes along the North-South Expressway. Eight selected slopes are chosen as study site. The study involves some methodologies. Research, data collection of slope data, rainfall data and vegetation data, data analysis using USLE method, distribution particle size test to determine soil types become very helpful methods in verifying results to meet the goals of project. The result from the USLE calculation shows tree or woody vegetation provides greater mechanical reinforcement and buttressing action because it has stronger and deeper rooted, so it is best for slope protecting, compared to fern and bushes that protect only surficial slope. Slopes with tree give the lowest value of soil loss in the range of 95.54 to 162.23 tons for all years, followed by slopes with bushes by 17134.92 to 60153.61 tons. Slopes with fern give the highest amount of soil loss with 24552.69 to 95059.04 tons. Hence, bushes give better protection towards soil erosion compared to fern. Thus, tree is the type of vegetation that works best in protecting soil erosion, followed by bushes and fern. Error in this estimation can occur because the USLE is an empirical equation that does not mathematically represent the physical processes of soil erosion. However, the relative results from different years may still be useful to predict the trend of soil erosion.

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NOTATION

A = computed soil loss per acre for a given storm period or time interval (ton/acre/year)

R = rainfall factor

K = soil erodibility

L = slope length factor (m)

S = steepness factor (%)

C = vegetation factor

P = erosion control practice factor

LS = slope factor

CHAPTER 1

1.0 INTRODUCTION

1.1 Background of Study

The phenomenon of slope failure occurs in much the same ways throughout the world with the fundamental causes do not differ greatly with geological and geographical locations. Therefore, the same methods of assessment, analysis, design and remedial measures can be applied for slope stability. In Malaysia, the factors that can contribute to slope failures are:

- Incorrect or improper design, analysis or construction
- High intensity rainfall
- Lack of maintenance

Malaysia is having erosion and slope stability problems due to heavy rainfall pattern and the residual soils that derived from the weathering of granite or other rocks, which are mostly sandy and silty. In general, the types of dense grass are sufficient to protect against erosion but it may not always be able to be applied in Malaysia because of the high and intense rainfall.

Concerns with slope stability have driven to various stabilization methods in improving soil strength. Vegetation is believed to be highly effective and advantageous for soil stabilization purposes by enhancing slope stability. However, different vegetation types are known to respond differently to slope.

In this study, the vegetations on slopes are classified into three groups which are fern, bushes and forested slope. Fern is naturally grown as uniformly dense vegetation, bushes are classified as dense vegetation with different types of vegetation, while forested slope is considered as mostly woody tree (about 80% of woody type, 15% of bushes and 5% of fern)..

1.2 Problem Statement

1.2.1 Problem Identification

North-South Expressway is an infrastructure network constructed to link North area and South area in Peninsular Malaysia. The expressway involves so many cut-off slopes during its construction. The disturbance slope has changed its stability that lead to slope failure such as erosion and landslide. The presence of water in slope also plays a critical role. Although there are many slope stabilization methods that have been used in Malaysia, there are still slope failure problems. It is may be due to high intense of rainfall that Malaysia experienced.

1.2.2 Significant of the Project

Throughout this project, the USLE method is used to determine the predicted annual soil loss on selected steep slopes along the North-South expressway. The most significant value of this method is to study the effects of vegetation on slope and how much the vegetation affects the slope stability. The problem focused on vegetation or C factor in different condition of soil, duration, slope length and slope steepness. Three different types of vegetation are chosen to evaluate its effectiveness in protecting slope from failure. These vegetations were naturally grown on slope in about 1 year after slope was cut-off for the purpose of expressway construction. The vegetation grew naturally like its origin condition and often maintenance work on vegetation are executed to prevent any hazards to the expressway users.

Besides vegetation, other factors also contribute to slope erosion. With USLE, we can verify how much contribution that every factor contributes to the soil erosion on slope with different types of vegetation. The factors include are soil erodibility factor, slope length and steepness factor and conservation practice factor.

1.3 Objective and Scope of Study

The objectives of this project are:

1. To investigate and analyze the effect of types of vegetation on slopes along the North-South expressway. This study involves three groups of vegetation, which are fern, forested and bushes.

2. To determine the predicted soil loss on slope along the North-South expressway using USLE method.

3. To determine which group of vegetation works best in protecting erosion.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Slope Instability

There are two types of slope failures, which are landslide and erosion. Landslide is displacement of soil from a slope with very fast rates of movement (Ortigao, 2004). Types of landslide are fall, topple, slide, spread and flow. A topple occurs in vertical with rotational in slope direction where slide is mass movement that present well-designed failure surface. They are classified into rotational, translational and complex slide depends on failure surface geometry. While, surficial erosion is the removal of surface layers of soil by the agencies of wind, water and ice (Gray and Sotir, 1995).

The decrease in shear strength and increase of shear stress are both leading to landslide (Duncan and Wright, 2005). Increase of shear stress is due to the loading on the top of slope or unloading at the slope base. While, reduction of shear strength is caused by the chemical weathering of minerals, disturbance and increases in pore water pressure. Water plays a role in many of the processes that reduce strength and increase shear stress (Duncan and Wright, 2005). Water influences how much loading presence on slopes that lead to the shear stress increase and shear strength decrease. Another factor is the presence of clay minerals in soils. When a slope fails, it is usually because of both effects of water and clayey soils. The behavior of clayey soil is much more complicated than the behavior of sands, gravels and non-plastic silts. The larger the content of clay minerals, and the more active the clay mineral, the greater is its potential for swelling, creep and strains softening (Duncan and Wright, 2005).

Most of landslide cases in Malaysia were due to the overflow of rainfall as Malaysia experiences tropical rainfall events (Dr. Roslan, 1998). The heavy rainfall causes the increasing of ground water level. The steep slope surfaces in Malaysia are exposed to the erosion and then results to slope failure. However, it is often the result of many factors which is related to the infrastructure development with poor planning, design, construction, and subsequent management of the environment. For man-made slopes, the factors that can contribute to slope failure are:

- Incorrect or improper design, analysis or construction
- High intensity rainfall
- Lack of maintenance

The landslide interrupted the expressway traffic flow. There are two major agents of soil erosion which are wind and water (Roslan, 2005). Factor which most influence soil erosion by water is mean annual rainfall. An annual rainfall of more than 1000 mm usually leads to dense forest vegetation (Roslan, 2005). Examples of landslide tragedy at North-South Expressway are captured in **Figure 2.1** and **Figure 2.2.**

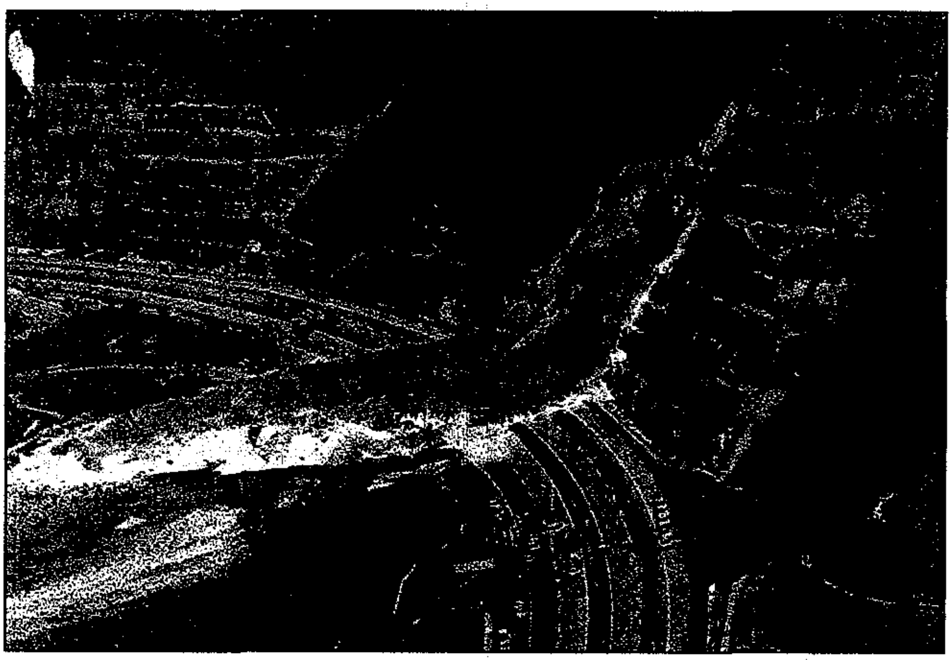

Figure 2.1: Landslide tragedy at Gua Tempurung, North-South Expressway on 6th January 1996. (Roslan, 2005)

Kawasan libatkan tiga negeri sepanjang Lebuh Raya Utara-Selatan

105 lokasi mudah runtuh

KUALA LUMPUR 12 Okt. -- Sebanyak 105 lokasi di sepanjang Lebuh Raya Utara-Selatan berpotensi untuk mengalami kejadian tanah runtuh pada bila-bila masa seperti yang berlaku di kawasan Gua Tempurung, Ipoh, semalam terutamanya dalam bulan ini.

Pengarah Pusat Penyelidikan Hakisan Tanah Negara (NASET), Universiti Teknologi Mara (UiTM), Prof. Dr. Roslan Zainal Abidin yang membuat kajian mengenai perkara itu sejak tahun 2000 berkata, kawasan berkenaan ialah 43 lokasi di Perak, 39 (Selangor) dan 23 (Negeri Sembilan).

Menurut beliau, punca menyebabkan kawasan itu mudah mengalami runtuhan tanah ialah muka buminya yang berlekuk.

"Berdasarkan kajian yang kami buat sejak tahun 2000, keadaan muka bumi yang bergeluk atau berlekuk merupakan satu tahap kritikal di mana runtuhan tanah boleh berlaku pada bila-bila masa, lebih-lebih lagi apabila hujan lebat.

"Berdasarkan data-data hujan yang diperoleh, kami dapati bulan Oktober merupakan bulan bahaya di sepanjang lebuh raya tersebut berikutan kadar hujan yang luar biasa, ia diikuti bulan April, September dan November," katanya.

Antara kawasan yang dikenal pasti berisiko tinggi mengalami tanah runtuh dikesan di Perak ialah di Sungkai, Slim River, Tapah, Bidor, Simpang Kampung Pulai dan Jelapang.

Dr. Roslan memberitahu hasil kajian berhubung hakisan tanah sepanjang lebuh raya itu kepada *Utusan Malaysia* hari ini ketika diminta mengulas kejadian tanah runtuh di Kilometer 303 Lebuh Raya Utara-Selatan berhampiran Gua Tempurung semalam.

Kejadian tanah runtuh kali kedua di kawasan yang hampir sama di Gua Tempurung itu menyebabkan seorang penunggang motosikal cedera parah.

Dalam kejadian itu juga, empat kenderaan termasuk sebuah lori turut terperangkap berhampiran tanah runtuh pada keja-

Figure 2.2: Landslide at KM 303 North-South Expressway on 11 October 2004.

(Roslan, 2005)

2.2 Types of water erosion

Three common types of water erosion are sheet, rill and gully. Sheet is due to the impact of falling rain drops. Soil is removed by surface runoff in uniform removal of a thin layer. Rill transports soil particles greater than in the sheet erosion due to acceleration of the moving water. Soils erode downwards and may extend into the subsoil. While gully gives ugly scars on the landscape, reduce the economic value of the land, damage installations and completely devastate the agricultural potential of the land .Gully development is closely related to the amount and velocity of runoff water (Roslan, 2005). **Figure 2.3** shows the illustration of types of soil erosion.

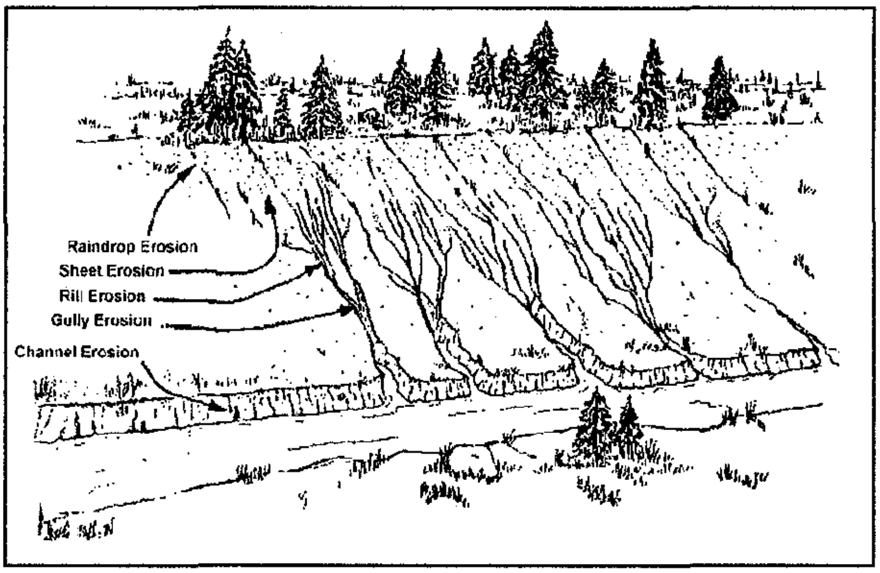

Figure 2.3: Types of soil erosion (Roslan, 2005)

2.3 USLE

Universal Soil Loss Equation is most widely method for estimating soil erosion. Although the model initially was developed based on 10,000 years of plots studies east of Rocky mountains in the US, the model has become one of the most widely used in the world with several applications in the tropics (Gregersen and Aalbaek). Several attempts have been made to modify and further develop the USLE, but the original USLE still remains the most widely used due to its simplicity (Gregersen and Aalbaek). This method is originally developed for agriculture and watershed purposes, but its use has been extended to predict slope erosion on steep slope. Soil erosion depends upon rainfall intensity, type of soil, land cover and land use, slope steepness and slope length.

The annual soil loss from a site is predicted according to the following relationships below:

$$A = R \cdot K \cdot LS \cdot C \cdot P \qquad (1)$$

2.3.1 R factor

R is the rainfall erosivity factor. It is the average annual summation values in a normal year's rain (EI). This index measures the erosion force of specific rainfall. The relationship between rainfall erosivity index and mean annual precipitation for the Peninsular Malaysia can be represented by following regression equation (Morgan, 1974):

$$R = P/2 \qquad \textbf{(2)}$$

This equation was used to estimate mean annual erosivity from mean annual rainfall (Morgan, 1974). The analyzing years in this study are from 1991 until 1995, from 1996 until 2000 and from 2001 until 2005.

2.3.2 K factor

Soil erodibility factor (K factor) gives an idea about the resistance of the soil to detachment and transport caused by rainwater. K factor represents the average long-term soil and soil-profile response to the erosive power associated with rainfall and runoff (Milward and Mersey, 1999). K factor is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. It is based on the nature of the topsoil. K factor values to be used in this study are in **Table 2.1.**

Table 2.1: K factor value (USEPA, Agriculture Research Service, U.S. Department of Agriculture, 1975)

Soil Type	K factor
Loamy fine sand	0.20
Very fine sand	0.36
Loamy very fine sand	0.38
Silty loam	0.42
Sandy clay loam	0.25
Clay loam	0.25
Silty clay	0.23

2.3.3 LS factor

Slope-length factor (LS factor) depends on percentage slope and length of the slope. L factor and S factor compute the effect of slope length and slope steepness on erosion. Values of L and S factors are relative and represent the relative erodibility of the particular slope length and steepness (Wang *et al.*, 2001). Steep slopes are assumed to produce high runoff velocities. Slope length (L) is the distance from the point of origin of the runoff to the point where the slope steepness decreases sufficiently to cause deposition or to the point where runoff enters a well-defined channel. Often the L and S factors are combined into a single topography factor, LS factor. This factor was calculated using equation below, (Wischemeir and Smith, 1978):

$$LS = (L/22.1)^{0.5}\,(0.065 + 0.045S + 0.0065S^2) \quad \textbf{(3)}$$

2.3.4 P factor

Factor P represents soil conservation practices that essentially slow the runoff water and thus reduce the amount of soil it can carry. The most important of these supporting practices are contour tillage, strip cropping, and terracing. Terraces reduce the slope length and slope steepness that, in turn, reduce the L and S in the USLE (Jianguo Ma, 2001).

2.3.5 C factor

Cropping management factor (C) depends on vegetation cover. Vegetation cover dissipates the kinetic energy of the rain drops before reaching to ground surface. C factor values were decided according to the type of land cover. The C factor can be used to compare the relative impacts of different types of vegetation on slope. This factor represents a comparison of soil loss and has a range between 0 and 1 where higher values mean more erosion (Jianguo Ma, 2001).

Table 2.2: The adopted value of *C* and area for different land use (Department of Agriculture, 1998)

No	Plant Cover	C Factor
1	Agriculture Station	0.5
2	Coconut	0.2
3	Diversified Crops	0.45
4	Estate Building and Associated	0.35
5	Fish and Hyacinth Ponds	1.00
6	Forest	0.003
7	Lalang	0.3
8	Mixed Horticulture	0.5
9	Newly Cleared Land	1.00
10	Orchards	0.35
11	Other Mining Areas	1.00
12	Paddy	0.45
13	Reclaimed Area	0.8
14	Recreational Area	0.8
15	Rubber	0.2
16	Scrub	0.3
17	Swamps	0.9
18	Unused Land	0.45
19	Urban Associated Area	0.8
20	Water	1.00

2.4 The effects of vegetation on slope

Vegetation provides a protective cover between the atmosphere and the soil, the major effects being hydrological and mechanical (Kruedener, 1951; Schiechtl, 1980; Schiectl and Stern, 1997). Vegetation influences the way in which water is transferred from the atmosphere to the soil by regulating infiltration of rainfall into the soil, and by intercepting rainfall and retarding runoff velocity, hence influencing the process and extent of erosion (Sotir and Gray, 1989).

Vegetation also influences the transfer of water from soil to the atmosphere, mediating the process both spatially and temporally via transpiration In addition to creating temporary effects that increase soil cohesion due to matrix suction, plants can achieve permanent increases to soil cohesion by effecting the long-term rearrangement of soil particles due to the suction forces (Silva, 1999). In a direct mechanical sense, vegetation increases the strength and competence of the soil by root reinforcement. A root-permeated soil behaves as a composite material in which fibers of relatively high tensile strength are embedded in a matrix of lower tensile strength. The root reinforcement of shallow slope failure is illustrated in **Figure 2.4**.

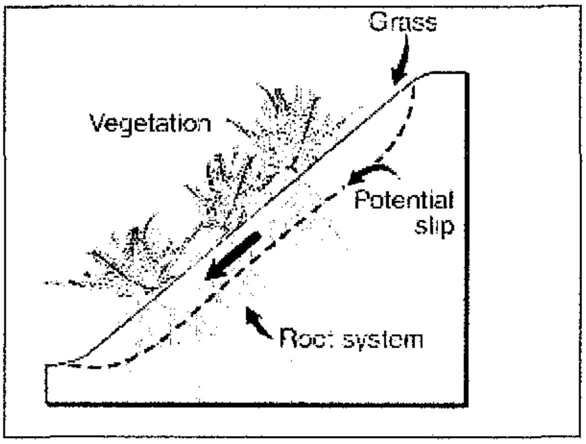

Figure 2.4: Reinforcement of shallow slope failure (Silva, 1999)

Woody vegetation is known to provide greater mechanical reinforcement and buttressing action because it has stronger and deeper rooted, so it is best for mass stability. Woody vegetation affects mass stability on slopes through root reinforcement, soil moisture depletion, buttressing and arching and surcharge. Other process is through soil evapo-transpiration and interception in the foliage can limit increase of positive pore water pressure. In the woody vegetation, stems can act as reinforcement to neutralize downslope shear force. The weight of vegetation can also increase stability via increased confining stress on failure surface. Woody vegetation growing on slopes reinforces soils and enhances stability; conversely, its removal should weaken soils and destabilize slopes (Gray and Sotir, 1995). While, grasses and herbaceous vegetation grows close to the surface and provide a tight, dense ground cover may lower the rates of surficial erosion (Gray and Sotir, 1995).

The roots that cross the edges of the failure stretch as the soil moves, setting up a tension in the roots, acts to resist further movement (Gray and Sotir, 1995). Gray and Sotir summarize that vegetation generally affects the surficial and mass stability of slopes in many ways. The beneficial effects of this vegetation are through interception, restraint, retardation and infiltration process (Gray and Sotir, 1995)

On the other hand, plants and their residues help to maintain soil porosity and permeability by infiltrating the water. Water which is the immense factor of landslide can be controlled by the vegetation soil protective but how far its effectiveness is mostly depends on types of vegetation and soil process condition (Silva, 1999)

2.5 Hydrological and mechanical mechanism

The effects of vegetation on slope instability can be grouped into two broad mechanisms:

- Hydrological - the process of water use and movement in the slope when living plants exist in the soil
- Mechanical - the contribution arises from the physical interactions of either the foliage or the root system of the plant with the slope

Table 2.3 shows the hydrological and mechanical mechanisms in vegetation.

Table 2.3: Hydrological and mechanical mechanisms (Greenway, 1987)

Mechanism	System	Influences
Hydrological	Foliage intercepts rainfall	Reduce rainfall available for infiltration
	Roots and stems increase the roughness	Increase infiltration capacity
	Roots extract moisture from soil, moisture that is lost to the atmosphere via transpiration	Leading to lower pore water pressure
	Depletion of soil moisture may accentuate desiccation cracking in the soil	Higher infiltration capacity
Mechanical	Roots reinforce the soil	Increase shear strength
	Tree roots anchor into firm strata	Provide support to the upslope soil mantle through buttressing and arching
	Weight of trees surcharges the slope	Increase normal and downhill force component
	Vegetation exposed to wind	Transmit dynamic forces into slope
	Roots bind soil particles at the ground surface and increase surface roughness	Reduce susceptibility to erosion

CHAPTER 3

3.0 METHODOLOGY

The project implementation has been undergone for about two semesters. The techniques listed below are actually techniques that have been applied into the project. The flow chart of method is illustrated in **Figure 3.1.**

3.1 Research and Literature Review

The research were done through reading and understanding from literature reviews, case studies, journals, text books, websites, articles, information and ideas from the supervisor and other reading materials. It is a self study to understand more and to get as much knowledge about the project. The gathered information were digested and converted into summarization for analysis purposes.

3.2 Data collection

Data collection is one of the methods, where data, figures, information, and records can be collected. It includes interviews, questionnaires, collecting samples and site observation. It also may include the new invention in research. Slope length, slope steepness, slope height and types of vegetation were collected from PLUS Expressway Berhad. These data is to measure slope factor and crop factor. Moreover, soil samples of selected slope were collected to determine the types of soil to measure soil erodibility factor. Besides, the record of daily rainfall amount at Kuala Kangsar Rainfall Station had been collected from Jabatan Pengairan dan Saliran from the year 1991 to 1995, from 1996 to 2000 and from 2001 to2005 for the purpose of measuring rainfall-runoff factor.

See **Appendix A** to **Appendix E** for detailed data collected.

3.2.1 Slope data

Slope length, slope steepness, slope height and angle were collected. Slope length in meter is used to determine L factor. This data can be straightly taken from the data collected. S factor is taken from slope angle data. Slope angle data collected is in degree. To measure the soil loss using USLE method, this data must be converted to the percentage of slope. The detailed calculation of slope angle in percentage is shown in **Appendix D**.

3.2.2 Record of daily rainfall amount

Record of daily rainfall amount was collected from Jabatan Pengairan dan Saliran from the year 1991 to 2005 at rainfall station at Kuala Kangsar, Perak. The range of year then were distributed into three classes, which are 1991-1995, 1996-2000 and 2001-2005 to determine the R factor for every 5 years. The **equation (2)** was used to get the R factor for every range of years. P value was obtained by calculating the mean annual total rainfall for every 5 years. Then, P value obtained was divided by 2, to get R factor.

3.2.3 Soil samples at selected slopes

Four soil samples at selected slopes were taken for sieve analysis test results to determine types of soil for K factor. The K value can be obtained from **Table 2.1**.

3.2.4 Observation

This kind of method is used to observe the vegetation on selected slopes. This is important to get to know the types of vegetation to determine the C factor on each selected slopes. **Appendix E** shows the types of vegetation on study slopes.

3.3 Experiment of soil samples

The sieve analysis tests were carried out to determine the size distribution of soil using dry sieving. The soil samples are taken from the selected slopes at North-South Expressway. Four samples were taken from each of 8 of selected slopes in order to get more precise results. The soils were dried in 100°C oven before it was sieved using mechanical sieve shaker. 15 minutes had been taken to sieve each 500 gram of samples. The results were reported as tables and expressed on semi-logarithmic chart. This experiment was done to measure the soil erodibility factor. After obtaining the types of soil, the K factor was determined. The results from the test are shown in **Appendix C**.

The data collected was analyzed regarding the factor needed in USLE. Data analysis will be done based on collected data from contractor and the output of laboratory tests. The result obtained from data analysis will be discussed and concluded.

3.4 Results

Soil loss assessment for this project is based on the USLE method. This equation was designed for soil erosion prediction. Result obtained from data collection, calculation, observation and output of laboratory will be discussed and concluded later.

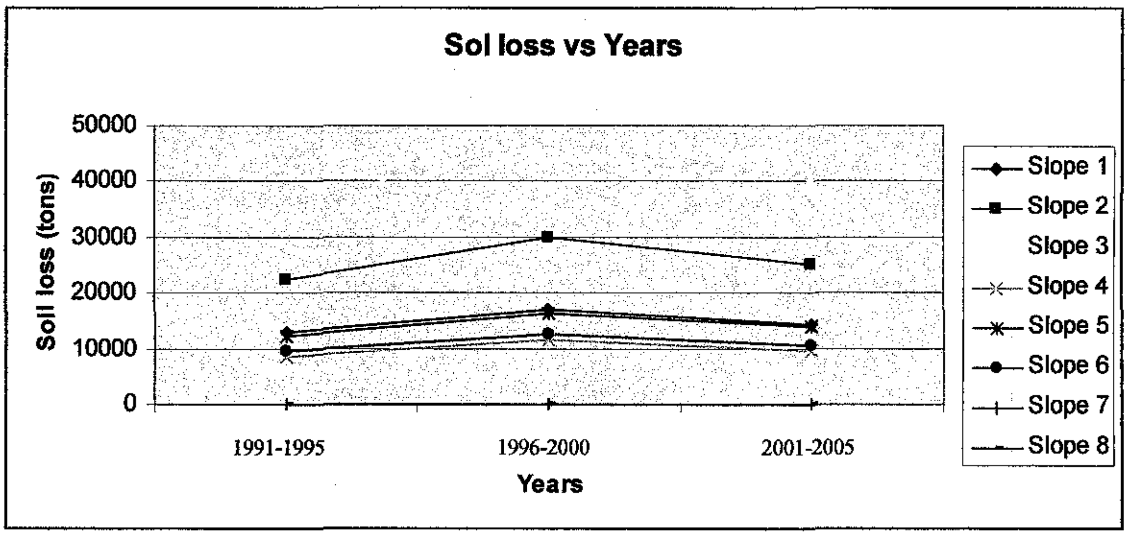

Figure 4.2: Soil Loss in years

From **Table 4.5** and **Figure 4.2**, it shows that Slope 8 gives the lowest predicted soil loss followed by Slope 7 for every period of years. It explains that Slope 8 and Slope 7, which both represent forested slope, give the best protection to the slope compared to the fern and bushes type. The soil losses for Slope 8 are in the range of 47.77 to 63.78 tons. While, for Slope 7, the range of soil losses are in the range of 60.75 to 81.13 tons. However, the highest soil losses in Slope 8 and Slope 7 are during 1996 to 2000, which are 63.78 tons and 81.13 tons respectively, due to heavy rainfall during 1996 to 2000.

From **Figure 4.2**, it shows that bushes type give better protection to slope stability after the forested slope. Majority slopes that represent bushes type have lower soil loss compared to the slopes that represent fern type during all periods of year. Soil losses for bushes type is in the range of 8567.50 to 30076.83 tons. While, the range of soil loss for slopes with fern is from 12276.36 to 47529.54 tons. Hence, bushes give better protection towards soil erosion compared to fern.

Besides vegetation factor, rainfall contributes to the soil loss in year. From 1996 to 2000, the predicted soil loss is the highest for all slopes with the range of 63.78 to 47529.54 tons. Whereas, the lowest soil loss is during 1991 to 1995 with the range of 47.77 to 35600.28 tons. This is due to the higher amount of rainfall during 1996 to 2000 and less amount of rainfall during 1991 to 1995 at site area.

CHAPTER 5

5.0 CONCLUSION AND RECOMMENDATION

The result from the USLE calculation shows the types of vegetation work best in protecting soil loss. The results are summarized as follows:

1. Forested or woody vegetation provides greater mechanical reinforcement and buttressing action because it has stronger and deeper rooted, so it is best for slope protecting, compared to fern and bushes that protect only surficial slope.

2. The soil losses for slopes that represent forested slope (Slope 7 and Slope 8) have the range of 47.77 to 81.13 tons of soil loss during all periods of year. Majority slopes that represent bushes type have lower soil loss compared to the slopes that represent fern type during all periods of year but higher than slopes with tree. Soil losses for bushes type is in the range of 8567.50 to 30076.83 tons for all periods of year. While, the range of soil loss for slopes with fern is from 12276.36 to 47529.54 tons. Hence, forested slope gives the best protection towards soil erosion, followed by bushes and fern.

3. Besides vegetation factor, rainfall contributes to the soil loss in year. From 1996 to 2000, the predicted soil loss is the highest for all slopes with the range of 63.78 to 47529.54 tons tons. This is due to the higher amount of rainfall during 1996 to 2000.

4. Forested is the type of vegetation that works best in protecting soil erosion

This project can be improved by:

1. Application of RUSLE (Revised Universal Soil Loss Equation). RUSLE is an erosion predicted and conservation planning tool based on large part of the Universal Soil Loss Equation (USLE) and its supporting data, but also including major improvement and updates.

2. Get more data on slope and land use management to obtain more accurate result.

3. Use variable slope steepness and different types of soil.

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APPENDICES

APPENDIX A

Study Area

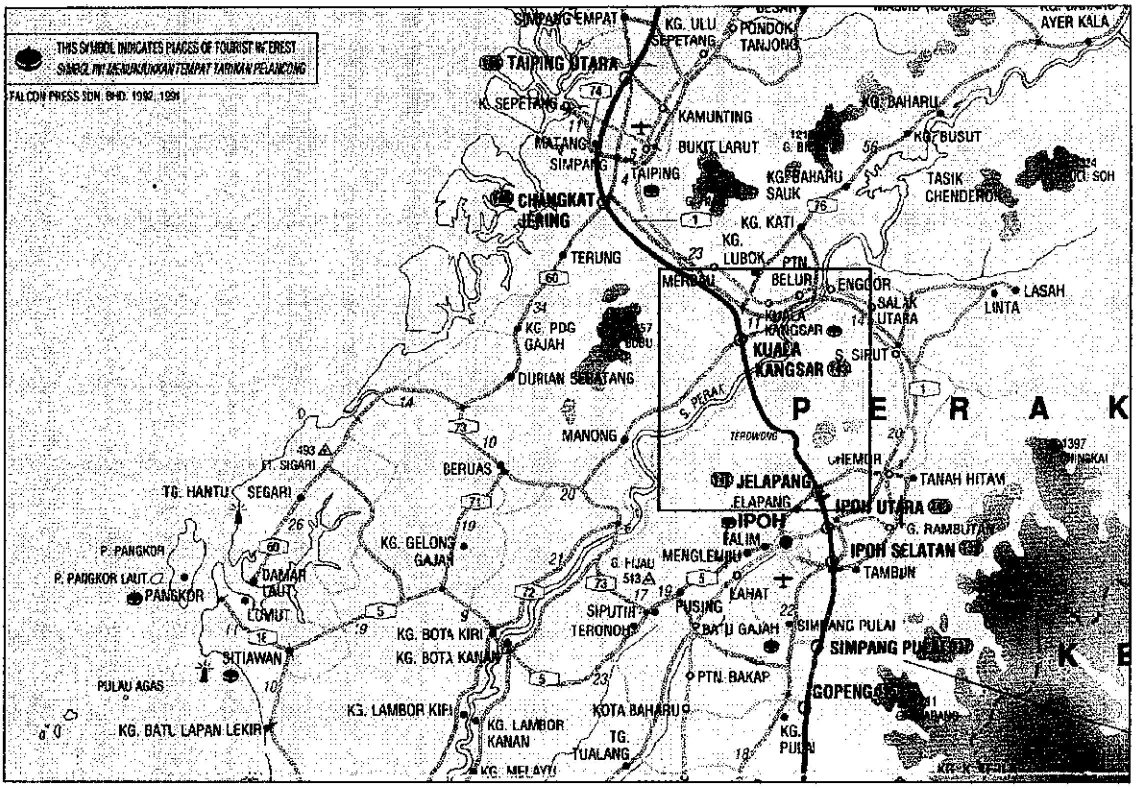


Figure1: North-South Expressway

Table 1: Selected slopes along the North-South Expressway

Slope No.	Slope ID	Start (km)	End (km)
Slope 1	SL/N5/ML/H/255.33/-/-/SB/E	255.10	255.55
Slope 2	SL/N5/ML/H/256.33/-/-/SB/E	256.05	256.60
Slope 3	SL/N5/ML/H/260.00/-/-/SB/C	259.88	260.22
Slope 4	SL/N5/ML/H/260.78/-/-/SB/C	260.55	261.00
Slope 5	SL/N5/ML/H/261.95/-/-/SB/C	261.85	262.05
Slope 6	SL/N5/ML/H/265.94/-/-/SB/C	265.97	266.20
Slope 7	SL/N5/ML/H/261.85/-/-/NB/C	261.90	261.80
Slope 8	SL/N5/ML/H/262.42/-/-/NB/E	262.58	262.25

Calculation for site area:

Area (m^2) = Length (m) X L (m)

Table 2: Site area

Slope ID	**Height (m)**	**L (m)**	**Length (m)**	**Area (m^2)**	**Area (acre)**
Slope 1	30	46.67	450	21001.5	5.19
Slope 2	50	77.79	550	42784.5	10.57
Slope 3	90	140.02	240	33604.8	8.30
Slope 4	30	46.67	450	21001.5	5.19
Slope 5	50	77.79	200	15558.0	3.84
Slope 6	50	77.79	230	17891.7	4.42
Slope 7	65	101.12	100	10112.0	2.50
Slope 8	25	38.89	330	12833.7	3.17

APPENDIX B

Daily totals Year 1991 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	1.5	0.0	0.0	2.0	34.5	0.0	0.0	0.0	2.0	3.0
2	24.0	0.0	13.0	2.0	0.0	34.5	8.5	0.0	1.0	0.0	29.0	0.0
3	0.0	0.0	0.0	8.5	6.5	7.5	3.5	23.0	0.0	0.0	10.0	0.0
4	0.0	0.0	0.0	6.5	0.0	0.0	14.0	1.0	0.5	0.0	0.5	0.0
5	0.0	0.0	0.0	7.0	15.0	0.0	4.0	0.0	6.0	0.0	14.0	0.0
6	0.0	26.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0
7	0.0	0.0	0.0	6.5	87.5	0.0	9.5	0.0	2.5	0.0	22.5	0.0
8	0.0	0.0	27.5	0.5	0.0	2.0	0.0	0.0	2.0	0.0	3.5	0.0
9	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	0.0
11	0.0	0.0	0.0	24.5	2.5	0.0	0.0	0.0	0.0	44.5	26.0	0.0
12	46.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0
13	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
14	3.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0
15	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	0.0	0.0	0.0
17	0.0	0.0	36.5	0.0	0.0	0.0	15.5	0.0	2.0	0.0	0.0	1.0
18	0.0	0.0	16.0	0.0	5.0	0.0	0.0	0.0	9.0	10.0	0.0	0.0
19	0.0	0.0	0.5	0.0	46.0	0.0	10.0	1.0	1.0	15.0	0.0	0.0
20	0.0	2.0	0.0	8.0	9.0	0.0	1.0	0.0	0.0	3.5	0.0	0.0
21	7.5	0.0	0.0	13.0	0.0	0.0	0.0	0.5	0.0	15.0	0.0	0.0
22	0.0	1.5	4.0	19.0	0.0	0.0	0.0	8.0	12.5	0.0	0.0	0.0
23	0.0	0.0	16.0	0.0	48.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0
24	0.5	0.0	0.0	0.0	43.5	0.0	0.0	0.0	1.5	0.0	22.5	0.0
25	0.0	0.0	3.5	0.0	0.0	20.5	0.0	24.0	0.0	0.0	0.5	0.0
26	0.0	14.5	0.0	3.5	16.5	0.0	0.0	16.5	0.0	0.0	0.0	6.0
27	0.0	45.0	0.0	0.0	6.0	8.0	0.0	1.0	1.0	0.0	0.0	0.0
28	0.0	43.5	0.0	3.5	8.5	0.0	0.0	9.0	2.0	0.0	0.0	24.5
29	0.0		9.0	0.0	5.5	8.0	0.0	4.0	9.5	2.5	19.5	6.0
30	0.0		0.0	0.0	52.0	0.0	0.0	10.0	0.5	6.0	0.5	0.0
31	0.0		0.5		39.5		0.0	0.0		1.0		11.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	88.0	133.0	128.0	103.0	393.0	82.5	121.0	98.5	63.0	109.5	158.0	66.0	1543.5
Max	46.5	45.0	36.5	24.5	87.5	34.5	34.5	24.0	12.5	44.5	29.0	24.5	87.5
NO>0.0	15	6	11	13	17	7	10	12	17	11	14	8	141

Daily totals   Year 1992   site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	31.0	42.5	0.0	0.0	22.5	0.0	0.5	0.0	0.0	0.0	6.0	0.0
2	0.5	0.0	0.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.5	0.0	0.0	2.5	0.0	0.0	0.0	1.5	0.0	52.0	0.0	0.0
4	0.0	8.0	0.0	0.5	0.0	6.0	28.0	1.5	0.0	0.0	0.0	0.0
5	1.5	27.0	0.0	8.0	11.5	0.0	4.0	0.5	0.0	0.0	0.5	8.0
6	0.0	1.5	0.0	0.0	19.0	1.5	0.0	0.0	1.5	2.0	0.0	1.5
7	0.0	0.0	15.5	0.0	0.0	0.0	34.0	0.0	0.0	0.0	0.0	1.0
8	5.0	40.0	23.0	0.5	0.0	27.0	4.0	0.0	0.0	0.0	0.0	12.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	16.0	0.0
10	0.0	0.0	0.5	0.5	0.0	0.0	0.0	2.5	6.0	0.0	0.0	0.0
11	0.0	0.0	3.0	0.0	0.0	2.0	11.0	1.0	0.0	1.0	19.0	0.5
12	0.0	0.0	43.0	0.0	0.5	0.0	1.0	4.5	0.0	0.0	0.0	12.0
13	0.0	0.0	0.0	0.0	0.0	0.5	3.5	6.0	0.0	1.5	0.0	10.5
14	0.0	0.0	0.0	2.0	10.5	0.5	0.0	0.0	0.0	0.0	1.5	0.0
15	0.0	0.0	0.0	6.0	8.0	2.0	0.0	0.0	0.0	0.0	5.0	0.0
16	0.0	0.0	4.5	6.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	?	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	13.5	?	0.0	0.5	0.0	0.0	24.0	1.5	21.5	0.0
19	0.0	0.0	0.0	?	0.0	0.0	9.5	7.0	0.0	0.0	9.5	0.0
20	0.0	0.0	0.0	?	0.0	0.0	0.0	0.0	4.5	3.0	2.0	0.0
21	0.0	0.0	0.0	?	1.0	0.0	0.5	0.0	0.0	0.0	5.5	0.0
22	2.0	16.5	0.0	?	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.5
23	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	13.5	9.0	5.0	0.0
24	8.5	0.0	16.5	0.0	0.0	0.0	0.0	0.0	10.5	0.0	21.5	16.5
25	1.0	0.0	0.0	0.4	0.0	0.0	0.0	6.5	8.5	1.0	3.5	4.5
26	0.0	0.0	17.0	0.9	0.5	2.0	0.0	13.5	3.5	13.5	0.0	0.0
27	0.0	0.0	0.0	0.9	12.0	0.0	62.5	0.0	0.0	9.5	0.0	16.0
28	0.0	0.0	0.0	0.9	0.0	0.0	2.5	36.0	3.5	19.5	0.0	41.0
29	0.0	0.0	0.0	0.8	0.5	0.0	0.0	0.0	5.5	2.0	0.0	0.5
30	0.0		0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0		21.0		0.0		0.0	0.0		0.0		0.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

0.0 0.0
Tot 50.0 135.5 157.5 59.5 88.0 44.0 161.0 87.5 81.0 115.5 118.5
125.5 1223.5
Max 31.0 42.5 43.0 22.0 22.5 27.0 62.5 36.0 24.0 52.0 21.5
41.0 62.5
NO>0.0 8 6 10 15 11 10 12 13 10 13 14
13 135

Daily totals Year 1993 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	6.5	3.5	0.0	0.0	7.0	11.0	0.0
2	0.0	0.0	0.0	2.0	0.0	0.0	11.5	0.0	0.0	14.0	5.0	63.0
3	0.0	0.0	0.0	0.0	0.5	24.0	3.0	0.0	11.5	23.5	7.5	1.0
4	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	1.0	5.5	4.0	22.0
5	40.5	8.0	0.0	0.0	0.5	6.5	18.0	0.0	25.5	27.0	17.0	91.5
6	21.5	0.0	12.5	0.0	26.5	25.5	0.5	0.0	6.0	0.0	9.5	29.0
7	0.0	0.0	6.0	0.0	0.0	5.5	0.0	0.0	5.0	13.0	6.5	0.0
8	0.0	0.0	8.0	0.0	1.0	0.0	7.0	2.5	0.0	2.0	12.0	0.0
9	0.0	9.5	1.5	0.0	0.0	0.0	0.0	0.0	1.0	2.0	21.5	7.0
10	0.0	0.5	0.0	4.0	5.5	0.0	0.0	0.0	0.0	8.5	3.0	5.5
11	0.0	0.0	2.5	0.0	16.0	5.5	0.0	0.0	0.0	0.0	7.0	7.5
12	0.0	3.0	16.5	0.0	48.5	0.0	0.0	0.0	0.0	1.5	10.0	5.5
13	22.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	35.0	1.5	1.5	11.5
14	49.0	0.0	2.0	0.0	3.0	26.0	0.0	0.0	0.0	3.5	10.0	0.0
15	1.5	0.0	33.0	4.0	0.5	0.0	66.5	0.0	0.0	10.0	0.0	0.0
16	10.0	23.5	0.5	0.0	0.5	0.0	7.5	0.0	0.5	13.5	0.0	0.0
17	3.5	27.0	0.0	3.5	0.0	0.0	3.0	34.5	0.0	3.5	0.0	13.0
18	6.5	0.0	0.0	0.0	0.5	0.0	12.5	0.0	0.0	1.5	0.0	0.0
19	33.0	0.0	58.0	0.0	1.5	1.5	0.5	0.0	3.5	9.5	0.0	0.0
20	0.0	0.0	0.0	4.0	0.5	0.0	0.0	34.0	3.5	7.0	48.5	0.0
21	0.0	0.0	0.0	25.5	5.0	0.0	0.5	6.5	0.0	2.0	9.0	1.0
22	0.0	0.0	0.0	30.5	6.0	0.0	1.0	0.0	28.5	0.0	27.0	3.5
23	?	0.0	0.0	18.0	3.0	0.0	0.0	0.0	0.5	2.5	81.5	4.5
24	?	0.0	0.0	10.5	0.0	0.0	0.0	11.5	5.5	0.5	1.5	0.0
25	?	0.0	0.0	2.5	6.5	0.0	3.0	5.0	9.0	0.0	25.0	29.0
26	?	3.5	0.0	0.0	32.5	0.0	27.0	0.0	12.0	0.5	0.0	0.0
27	7.0	7.5	0.0	0.0	1.0	2.0	2.5	1.5	4.5	0.0	0.0	0.5
28	0.0	5.0	0.0	0.0	1.5	0.5	0.0	15.0	0.0	47.0	3.5	0.0
29	0.0		0.0	0.0	26.5	5.0	0.0	7.0	0.0	17.0	1.5	0.0
30	0.0		18.5	0.0	0.0	53.0	0.0	0.0	2.0	1.0	0.0	0.0
31	0.0		0.0		17.5		0.0	0.0		9.5		6.5
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	194.5	87.5	160.5	104.5	204.5	161.5	171.0	117.5	154.5	234.0	323.0	301.5	2214.5
Max	49.0	27.0	58.0	30.5	48.5	53.0	66.5	34.5	35.0	47.0	81.5	91.5	91.5
NO>0.0	10	9	12	10	23	12	17	9	17	26	22	17	184

Daily totals Year 1994 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	16.0	34.0	0.0	
2	0.0	0.0	15.0	0.0	1.0	0.0	2.0	6.5	17.0	0.5	0.0	59.5	
3	9.0	6.5	0.0	0.0	0.0	0.0	0.5	21.0	5.5	0.5	0.0	0.0	
4	0.0	0.5	0.0	0.0	2.5	0.0	0.0	0.0	32.0	16.5	0.0	14.5	
5	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	19.5	14.0	1.0	
6	0.0	26.5	8.0	0.0	3.0	12.5	0.0	0.0	0.0	4.0	0.0	?	
7	48.0	13.5	0.5	0.0	1.5	0.0	0.0	0.0	23.5	0.0	44.5	?	
8	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.5	3.0	1.0	0.0	?	
9	13.0	35.5	32.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.0	?	
10	?	0.0	10.0	0.0	0.0	7.0	3.5	0.5	1.0	0.5	4.5	?	
11	?	0.0	2.0	0.0	0.0	0.5	0.0	1.5	0.0	2.5	1.5	?	
12	?	0.5	5.0	0.0	0.0	1.5	0.0	10.0	2.0	3.5	5.0	?	
13	?	0.0	0.0	0.0	0.0	4.0	0.0	4.5	0.0	0.0	5.0	?	
14	?	11.5	0.0	21.5	22.0	0.5	0.0	0.0	0.0	4.0	5.5	?	
15	?	3.5	1.5	2.0	8.0	3.5	0.0	2.5	0.0	0.0	0.0	?	
16	?	1.5	0.0	28.5	0.0	1.5	0.0	0.0	2.5	0.0	0.0	?	
17	?	0.0	1.5	8.5	0.0	0.0	0.0	23.5	7.0	6.5	0.0	?	
18	?	14.5	28.5	11.5	4.0	0.0	0.0	0.0	5.5	7.0	6.5	?	
19	?	0.0	2.0	0.0	0.0	0.0	0.0	23.0	0.0	3.0	0.0	?	
20	?	0.0	2.5	20.5	2.5	0.0	0.0	0.0	0.0	4.0	12.0	0.0	
21	?	0.0	0.0	0.0	20.5	2.0	0.0	0.0	0.0	38.5	5.0	0.0	
22	6.0	0.0	1.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
23	0.5	0.0	37.5	4.5	0.0	0.0	0.0	5.0	2.5	0.0	0.0	0.0	
24	0.0	0.0	15.5	14.0	0.0	0.0	0.0	19.0	4.0	0.0	10.0	0.0	
25	0.0	0.0	0.0	19.5	0.0	4.5	0.0	2.0	0.0	0.0	34.5	0.0	
26	11.0	0.0	12.5	0.0	0.0	0.5	0.0	8.5	1.5	0.0	10.5	0.0	
27	0.0	0.0	1.5	0.0	0.0	0.0	0.0	63.0	0.0	5.0	1.5	5.0	
28	5.0	11.5	0.0	3.5	0.0	15.0	0.0	0.5	1.0	0.0	1.0	23.0	
29	0.0		2.5	0.0	2.0	2.0	0.0	0.0	15.5	0.0	21.0	0.0	
30	0.0		3.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	10.0	1.0	
31	7.0		0.5		0.0		0.0	0.0		0.0		3.5	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tot	99.5	136.5	203.5	135.0	76.0	55.0	6.0	191.5	123.5	133.0	228.0	107.5	1495.0
Max	48.0	35.5	37.5	28.5	22.0	15.0	3.5	63.0	32.0	38.5	44.5	59.5	63.0
NO>0.0	8	12	21	11	12	13	3	16	15	18	19	7	155

Daily totals Year 1995 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	7.5	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	10.0
2	4.0	0.0	0.0	0.0	10.5	0.0	0.0	42.0	0.0	0.0	0.0	2.5
3	0.0	0.0	0.0	28.0	0.0	55.5	39.0	0.5	0.0	0.0	0.0	0.0
4	6.0	0.0	36.5	19.0	0.0	1.5	0.0	3.0	0.0	0.0	0.0	5.0
5	0.0	0.0	0.0	5.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	32.0	5.0	0.0	0.0	0.0	0.5	0.0	3.0
7	0.0	0.0	34.0	26.5	5.0	12.0	0.0	0.0	0.5	0.0	0.0	34.0
8	0.0	0.0	0.0	0.0	3.5	7.5	0.0	0.0	0.0	0.0	5.5	1.0
9	8.0	0.0	0.0	0.0	10.5	0.0	0.0	0.0	17.5	2.5	69.0	40.5
10	26.0	3.0	0.0	14.5	4.5	12.0	0.0	26.0	0.5	0.0	2.0	0.0
11	6.5	10.5	5.0	20.0	0.0	13.5	0.0	29.5	0.0	0.0	2.5	0.0
12	0.0	0.0	0.0	0.5	0.0	0.0	0.0	1.5	1.0	4.5	9.5	0.0
13	0.0	11.0	0.0	0.0	0.0	0.0	0.0	38.0	1.0	0.0	0.0	0.0
14	0.0	23.0	0.0	0.5	0.0	22.0	0.0	19.5	22.0	0.0	5.0	0.0
15	0.0	0.0	0.0	5.5	0.0	0.0	0.0	4.5	1.0	3.0	1.5	0.0
16	0.0	0.0	0.0	0.0	0.0	2.5	0.0	62.0	12.0	2.0	11.0	0.0
17	0.0	0.0	2.5	0.0	0.0	11.0	0.0	0.0	73.5	1.0	39.5	0.0
18	2.0	0.0	9.5	0.0	4.0	0.0	0.0	11.5	0.0	61.5	22.5	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	41.0	20.0	0.0	6.5	0.0	0.0
20	0.0	0.0	41.5	0.0	0.0	1.0	0.0	6.0	0.0	0.0	0.0	3.0
21	2.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
22	0.0	0.0	0.0	32.0	1.0	0.0	0.0	1.5	4.0	0.0	9.0	4.5
23	18.0	0.0	4.5	9.5	4.5	0.0	9.0	0.0	6.0	0.5	3.0	0.0
24	0.0	25.5	1.5	7.0	0.0	1.5	2.5	0.0	0.0	1.5	5.0	28.5
25	8.5	0.0	8.0	29.0	12.5	0.0	0.0	0.0	2.5	0.0	27.5	0.5
26	0.5	16.5	0.0	14.0	1.0	0.0	4.5	10.0	16.0	0.5	0.0	0.0
27	23.5	0.0	0.0	4.5	21.5	39.5	0.0	0.0	59.0	0.0	0.0	0.0
28	0.0	0.0	0.0	57.5	0.0	3.0	0.0	0.0	14.0	20.0	0.0	0.0
29	0.0		0.0	29.5	12.5	0.0	0.0	0.0	1.5	15.5	2.5	0.0
30	0.0		0.5	0.0	0.0	0.0	1.5	0.0	0.0	50.5	0.0	0.0
31	0.0		0.0		0.0		0.5	2.5		0.0		0.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	105.0	94.0	151.0	302.5	123.0	194.0	103.5	278.0	232.0	170.0	215.0	134.5	2102.5
Max	26.0	25.5	41.5	57.5	32.0	55.5	41.0	62.0	73.5	61.5	69.0	40.5	73.5
NO>0.0	11	7	11	17	13	15	8	16	16	14	15	12	155

Daily totals Year 1996 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	12.0	0.0	0.0	0.0	27.5	0.0	0.0	2.5	0.0	0.0	0.0
2	0.0	5.5	0.0	0.0	0.0	6.5	7.0	0.0	5.0	11.0	0.0	4.5
3	0.0	0.0	0.0	0.0	0.0	0.5	5.0	0.0	0.0	30.0	0.0	2.5
4	0.0	1.5	0.0	?	7.0	0.0	15.0	0.0	0.5	11.0	0.0	64.5
5	0.0	0.0	0.0	?	1.0	15.0	16.0	0.0	0.5	6.5	0.0	2.5
6	21.5	0.0	0.0	?	0.0	1.5	0.0	0.0	8.0	2.0	0.5	5.5
7	3.5	24.5	0.0	?	3.5	0.0	0.0	63.5	6.0	0.0	10.0	1.5
8	0.0	0.0	0.0	?	0.0	9.0	1.0	4.0	7.5	27.5	0.5	0.5
9	0.0	0.0	0.0	?	5.5	6.0	0.0	21.5	0.5	38.0	20.0	8.0
10	4.0	0.0	6.3	0.3	1.0	1.0	0.0	0.0	0.5	3.0	6.0	27.5
11	3.0	0.0	0.0	0.0	0.5	0.0	0.0	7.0	0.0	12.0	2.5	2.5
12	0.0	0.0	0.0	6.5	2.0	0.0	0.0	26.5	0.0	2.0	1.0	0.0
13	0.0	0.0	0.0	0.6	0.0	0.0	9.5	0.0	0.0	2.0	0.0	0.0
14	0.0	42.5	0.0	0.0	27.0	0.0	34.0	0.0	0.0	2.0	79.5	0.0
15	0.0	1.5	0.0	0.0	5.5	0.0	0.0	1.0	1.5	9.0	65.5	12.0
16	0.0	0.5	43.9	9.6	0.0	0.0	0.0	4.0	0.5	2.0	0.0	0.0
17	0.0	17.0	17.0	2.4	0.5	0.0	0.0	6.5	0.0	1.5	1.0	0.0
18	0.0	0.0	0.7	0.0	0.0	0.0	0.0	26.2	1.5	0.0	4.0	4.0
19	0.0	3.0	27.9	25.0	0.0	0.0	0.0	4.3	1.0	8.5	0.0	0.5
20	0.0	0.0	6.5	0.0	0.0	0.0	0.0	5.5	0.0	14.5	3.5	4.5
21	0.0	0.0	2.9	1.5	0.5	0.0	0.0	4.0	0.0	3.0	0.0	21.5
22	0.0	0.0	16.8	0.0	0.5	0.0	0.0	0.0	8.0	1.5	0.0	0.0
23	32.5	0.0	17.8	5.0	0.0	28.5	0.0	0.0	0.0	3.5	1.0	0.0
24	51.0	0.0	0.0	0.5	0.0	13.0	0.0	0.0	0.5	4.5	1.0	0.0
25	5.5	14.5	14.9	20.5	0.0	0.5	0.0	26.5	0.0	3.5	0.0	0.0
26	26.0	0.0	0.0	0.5	0.0	0.0	0.0	2.5	0.0	29.0	15.0	0.0
27	0.0	7.0	0.0	20.5	0.0	0.0	0.0	17.5	0.0	27.0	0.0	0.0
28	8.0	0.0	0.0	0.5	0.0	7.0	0.0	0.0	0.0	6.5	0.0	0.0
29	24.0	0.0	0.0	2.0	0.0	4.5	0.0	31.0	0.0	5.5	4.5	0.0
30	0.0		0.0	18.0	28.5	29.5	0.0	13.0	0.0	0.0	9.5	0.0
31	8.5		0.0		4.5		0.0	27.5		0.0		0.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	187.5	129.5	154.7	113.4	87.5	150.0	87.5	292.0	44.0	266.5	225.0	162.0	1899.6
Max	51.0	42.5	43.9	25.0	28.5	29.5	34.0	63.5	8.0	38.0	79.5	64.5	79.5
NO>0.0	11	11	10	15	14	14	7	18	15	26	17	15	173

Daily totals Year 1997 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	4.0	9.5	0.0	14.0	0.0	0.0	6.5	4.0	0.0
2	0.0	12.0	0.0	6.5	0.0	8.5	19.5	0.0	3.5	0.0	4.5	0.0
3	0.0	12.5	0.0	0.0	8.5	4.5	1.0	0.0	38.5	0.0	0.0	4.5
4	0.0	0.0	0.0	0.0	0.0	13.5	0.0	0.0	1.5	23.2	0.5	0.0
5	0.0	1.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	2.8	12.0	21.0
6	0.0	16.5	0.0	38.0	0.0	1.5	7.5	0.0	4.0	7.0	10.5	0.5
7	0.0	0.0	0.0	2.0	29.5	0.0	0.0	0.0	3.0	15.5	0.5	3.0
8	0.0	0.0	5.0	0.0	0.0	0.5	0.0	0.0	13.5	11.0	0.0	27.5
9	0.0	0.0	0.0	0.0	0.5	0.0	10.5	0.0	0.0	1.5	19.5	0.0
10	0.0	6.5	0.5	2.5	13.5	0.0	0.0	0.0	9.0	0.5	0.0	0.0
11	0.0	1.5	0.0	2.0	2.5	0.0	0.0	0.0	12.5	0.0	51.5	0.0
12	0.0	0.0	0.0	1.0	2.0	14.5	0.0	0.0	0.0	0.0	3.5	1.5
13	0.0	39.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0	23.5	1.0	0.0
14	0.0	0.0	7.5	0.0	0.0	1.0	0.0	9.5	0.0	0.0	13.0	6.5
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	33.5	5.5	0.0
16	0.0	1.0	1.0	0.0	4.5	5.0	0.0	4.5	0.0	0.0	9.5	0.0
17	5.5	0.0	?	0.0	0.0	8.5	0.0	21.0	0.5	2.0	5.5	9.5
18	11.0	0.0	?	1.0	0.0	2.0	0.0	0.0	9.5	30.5	18.2	0.0
19	0.0	21.0	?	1.0	0.0	0.0	10.0	0.0	0.0	0.0	3.3	1.0
20	3.0	0.0	11.5	0.0	0.0	1.5	4.0	0.0	2.0	1.5	16.0	26.5
21	0.0	0.0	0.0	10.0	0.0	0.0	6.5	11.0	0.0	3.5	7.0	0.0
22	0.5	11.5	0.5	0.0	0.0	0.0	22.0	15.7	1.5	6.5	25.5	0.0
23	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	2.5	2.0	0.0
24	0.0	11.5	0.0	12.0	0.0	15.0	0.0	0.0	0.0	0.0	1.5	12.0
25	0.0	26.5	0.0	0.5	0.0	0.5	54.5	0.0	0.4	9.0	4.5	0.0
26	2.0	16.0	0.0	62.5	0.0	0.0	0.0	0.0	0.4	0.0	0.5	0.0
27	0.0	0.0	0.0	3.0	0.0	24.0	0.0	0.0	0.4	0.0	0.0	0.0
28	0.0	0.0	0.0	23.5	0.0	0.5	0.0	0.0	36.9	0.0	15.5	0.0
29	0.0		0.0	19.0	0.0	0.0	0.0	1.0	7.3	25.0	0.5	4.0
30	6.0		0.0	9.0	0.0	0.0	0.0	5.0	3.5	9.5	0.0	0.0
31	7.5		0.0		0.0		0.0	0.0		22.0		0.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

0.0 0.0

Tot	35.5	178.5	28.0	197.5	70.5	101.0	152.5	70.0	149.0	237.0	235.5	
117.5	1572.5											
Max	11.0	39.0	11.5	62.5	29.5	24.0	54.5	21.0	38.5	33.5	51.5	
27.5	62.5											
NO>0.0	7	14	7	17	8	15	11	9	19	20	25	
12	164											

Daily totals Year 1998 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	12.7	0.0	0.0	38.0	0.0	4.0	0.0	0.5	8.7	0.0	0.0	5.6
2	25.6	0.0	0.0	10.5	0.0	0.5	0.0	2.2	0.5	1.0	26.8	0.7
3	10.2	0.0	11.5	0.5	6.0	1.5	0.0	0.8	2.0	0.0	15.7	0.0
4	8.0	7.0	0.0	0.0	0.0	22.5	0.0	0.0	5.0	24.1	0.6	14.0
5	0.0	15.0	0.0	0.0	11.1	0.0	22.5	0.0	36.0	36.8	45.6	12.9
6	9.5	0.0	0.0	3.5	21.9	0.0	0.0	0.0	0.0	0.0	12.1	1.3
7	1.0	38.0	0.0	0.0	0.5	19.0	0.0	0.0	11.0	16.9	5.6	0.7
8	40.0	0.0	0.5	28.5	0.0	0.0	1.0	0.0	10.5	0.0	0.4	0.0
9	0.0	0.0	8.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	38.6	0.0
10	0.0	0.0	0.0	0.0	26.0	0.0	0.0	0.0	0.0	1.3	0.8	0.0
11	17.0	0.0	0.0	0.0	27.2	0.0	2.0	0.0	24.0	15.4	1.8	0.0
12	0.0	0.0	0.0	0.0	5.8	7.5	8.5	19.5	40.5	7.5	2.3	0.0
13	0.0	0.0	0.0	0.5	1.5	5.5	0.0	9.0	8.0	0.0	0.4	0.0
14	0.0	0.0	10.5	12.5	0.0	0.0	0.0	30.5	31.7	3.4	0.0	0.9
15	0.0	4.0	0.0	0.0	0.0	16.5	21.0	16.0	7.8	1.8	34.2	0.0
16	0.0	4.5	0.0	0.0	16.5	0.0	0.5	0.5	9.0	0.3	5.4	0.4
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	8.6	3.9	0.9
18	1.0	14.5	0.0	0.0	0.0	0.0	9.0	3.5	0.0	0.0	0.0	6.9
19	0.0	0.0	3.5	0.0	0.0	0.0	8.0	0.0	0.0	6.4	0.0	7.0
20	9.5	0.0	0.0	0.0	16.1	0.0	3.0	0.0	5.5	0.0	0.0	0.0
21	7.5	0.0	0.0	0.0	3.9	0.0	3.5	0.0	0.0	6.9	15.7	0.0
22	0.0	5.5	0.0	25.5	0.5	0.0	0.0	1.5	21.5	1.0	8.8	0.0
23	0.0	0.0	0.0	4.5	0.5	5.5	2.2	44.5	6.0	0.0	2.0	20.5
24	0.0	0.0	0.0	3.5	3.5	0.0	10.8	13.0	24.9	0.0	18.2	0.0
25	0.0	0.0	0.0	7.0	0.5	23.0	30.2	8.0	10.0	0.6	4.8	12.8
26	0.0	0.0	6.2	0.0	0.0	0.0	0.8	0.0	4.0	0.0	2.3	0.5
27	0.0	0.0	9.3	0.0	0.0	2.0	0.0	20.0	0.0	0.0	0.0	4.9
28	19.5	0.0	0.5	0.0	0.0	2.0	1.0	39.0	0.0	2.8	0.0	0.5
29	0.0		0.0	0.0	0.0	0.0	0.0	10.5	0.0	2.7	1.9	0.0
30	8.5		0.5	0.0	0.0	6.0	0.0	1.0	0.0	5.2	0.9	3.9
31	0.0		0.0		0.5		0.0	2.8		50.0		1.4
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	170.0	88.5	50.5	134.5	143.5	115.5	124.0	222.8	269.1	192.7	248.8	95.8	1855.7
Max	40.0	38.0	11.5	38.0	27.2	23.0	30.2	44.5	40.5	50.0	45.6	20.5	50.0
NO>0.0	13	7	9	11	17	13	15	18	20	19	23	18	183

Daily totals Year 1999 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	?	
2	0.0	6.8	0.0	76.0	0.0	0.0	12.4	0.0	10.7	1.9	0.0	?	
3	16.3	1.4	0.0	0.0	0.0	0.0	0.4	0.0	6.5	3.9	1.9	?	
4	0.0	35.5	7.4	0.0	0.0	0.0	0.0	0.0	20.0	37.6	2.7	?	
5	9.4	0.0	0.0	0.0	1.5	0.0	22.8	0.3	5.0	14.5	23.8	?	
6	1.5	0.0	0.0	0.5	13.9	0.0	0.4	33.3	0.0	5.0	0.0	?	
7	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0	?	
8	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	3.0	0.4	0.0	?	
9	2.4	23.9	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	?	
10	0.0	6.5	12.0	0.0	0.0	13.3	0.0	0.0	3.8	1.5	?	?	
11	0.0	7.1	4.0	22.7	6.9	13.4	0.0	0.9	5.4	23.1	?	?	
12	0.3	5.2	2.4	0.5	0.0	0.0	0.0	0.0	0.0	9.8	?	?	
13	27.5	0.0	4.8	0.0	0.0	9.1	14.5	4.5	0.0	10.7	?	?	
14	0.0	0.0	0.7	0.0	2.7	10.1	2.9	0.3	0.9	1.5	?	?	
15	24.6	0.0	0.0	9.0	0.4	13.3	0.0	0.0	0.0	0.0	?	?	
16	0.4	0.0	4.9	0.5	1.2	6.1	0.0	1.3	0.0	0.8	?	?	
17	12.5	14.0	3.5	8.9	0.0	0.0	0.0	0.0	2.3	0.9	?	?	
18	0.0	0.4	0.5	0.5	0.0	0.0	0.0	0.0	0.0	2.5	?	?	
19	11.3	0.0	1.5	0.0	10.4	0.0	0.0	0.8	32.5	0.4	?	?	
20	0.0	0.0	4.3	1.5	0.0	0.0	0.0	0.6	39.7	0.5	?	?	
21	0.0	0.0	0.0	4.7	3.1	1.0	16.6	48.9	0.9	0.0	?	?	
22	0.0	12.1	3.6	0.0	0.0	0.0	0.0	3.2	0.0	15.1	?	?	
23	28.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.7	50.9	?	?	
24	5.8	0.0	0.0	0.0	0.0	0.0	0.0	3.9	31.7	41.9	?	?	
25	58.7	1.9	11.8	0.0	0.0	0.0	0.0	14.5	3.0	0.0	?	?	
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	12.6	0.0	?	?	
27	0.0	0.0	0.0	0.0	0.0	0.9	0.0	3.3	53.0	0.0	?	?	
28	3.6	6.4	0.0	0.0	0.0	4.4	0.0	7.8	24.7	22.6	?	?	
29	0.0		4.0	0.0	0.0	31.5	0.0	0.0	15.0	4.4	?	?	
30	0.0		0.4	0.0	0.0	0.0	0.0	10.4	15.6	0.0	?	?	
31	0.0		17.5		0.0		0.0	0.0		0.0		?	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	?	0.0
Tot	203.2	121.2	91.5	124.8	48.8	103.1	81.0	134.5	325.0	252.4	31.0	?	1516.5
Max	58.7	35.5	17.5	76.0	13.9	31.5	22.8	48.9	53.0	50.9	23.8	?	76.0
NO>0.0	14	12	18	10	9	10	8	16	20	22	4	0	143

Daily totals   Year 2000   site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	?	0.1	?	0.0	?	6.6	0.0	7.0	46.7	0.0	2.8
2	?	?	0.0	?	0.0	?	2.5	4.3	0.0	3.0	0.0	0.0
3	?	?	0.0	?	4.3	?	0.0	2.5	16.1	1.4	0.0	0.0
4	?	?	0.0	?	0.6	?	1.0	1.7	0.0	8.1	4.5	1.5
5	?	?	0.5	?	16.3	1.4	0.0	2.0	0.0	0.6	?	0.0
6	?	?	0.0	?	0.0	16.7	0.0	0.0	0.0	26.4	0.0	13.5
7	?	?	20.2	?	0.3	3.4	0.0	0.0	0.0	0.0	0.0	0.0
8	?	?	0.0	?	0.6	3.1	0.0	1.0	5.0	7.9	2.1	0.0
9	?	?	81.4	?	0.0	0.0	0.0	2.9	15.5	0.0	39.8	0.0
10	?	?	0.5	?	0.0	0.0	0.0	12.0	0.0	0.0	3.4	0.0
11	?	?	0.0	?	2.8	37.2	0.0	6.5	0.0	0.0	13.1	0.0
12	?	?	0.5	?	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
13	?	?	0.5	?	0.0	0.0	0.0	1.6	0.0	18.6	3.0	0.0
14	?	?	0.0	?	0.0	0.0	0.0	0.0	0.0	0.8	1.1	0.5
15	?	?	0.0	0.0	0.0	0.0	0.0	19.2	16.0	1.6	1.0	24.5
16	?	1.4	0.0	6.4	0.0	0.0	0.0	0.0	0.0	29.5	8.6	9.0
17	?	20.4	0.0	0.0	0.0	0.4	0.0	0.0	5.2	2.4	10.4	0.5
18	?	0.2	0.0	0.0	3.2	8.4	1.6	0.0	8.7	7.3	1.5	0.0
19	?	3.5	7.4	0.0	0.0	0.0	0.0	3.5	13.8	9.9	4.4	69.5
20	?	0.0	13.6	0.0	0.0	0.0	0.0	1.9	5.6	0.0	20.2	2.5
21	?	0.0	13.7	32.3	2.2	0.0	0.0	0.0	38.5	1.2	5.7	35.5
22	?	24.6	0.0	17.1	0.0	7.4	31.7	0.0	23.4	3.3	1.2	42.5
23	?	0.6	27.2	32.2	0.0	0.0	0.0	0.0	6.0	0.0	2.5	0.0
24	?	55.6	54.1	11.6	10.9	0.0	0.0	0.0	0.0	0.0	1.3	0.0
25	?	28.1	0.0	0.0	0.0	0.0	7.2	0.0	1.2	14.1	0.0	13.0
26	?	28.9	84.5	0.7	1.5	3.9	3.0	0.0	10.2	24.1	0.0	0.0
27	?	31.5	0.5	35.8	1.5	0.0	0.0	0.0	4.3	7.6	10.5	0.0
28	?	2.8	41.7	7.4	0.0	0.4	4.5	0.0	0.0	3.3	0.0	9.5
29	?	0.7	?	0.0	0.0	14.1	0.0	0.0	14.0	7.7	0.0	1.0
30	?		?	8.7	21.2	7.7	0.9	0.0	4.7	0.0	0.0	16.0
31	?		?		?		50.3	0.0		0.0		0.0
Min	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

0.0 0.0

Tot	?	198.3	346.4	152.2	65.4	104.1	109.3	59.1	195.2	225.5	135.3	241.8	1832.6
Max	?	55.6	84.5	35.8	21.2	37.2	50.3	19.2	38.5	46.7	39.8	69.5	84.5
NO>0.0	0	12	15	9	12	12	10	12	17	21	19	15	154

Daily totals Year 1992 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	31.0	42.5	0.0	0.0	22.5	0.0	0.5	0.0	0.0	0.0	6.0	0.0
2	0.5	0.0	0.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.5	0.0	0.0	2.5	0.0	0.0	0.0	1.5	0.0	52.0	0.0	0.0
4	0.0	8.0	0.0	0.5	0.0	6.0	28.0	1.5	0.0	0.0	0.0	0.0
5	1.5	27.0	0.0	8.0	11.5	0.0	4.0	0.5	0.0	0.0	0.5	8.0
6	0.0	1.5	0.0	0.0	19.0	1.5	0.0	0.0	1.5	2.0	0.0	1.5
7	0.0	0.0	15.5	0.0	0.0	0.0	34.0	0.0	0.0	0.0	0.0	1.0
8	5.0	40.0	23.0	0.5	0.0	27.0	4.0	0.0	0.0	0.0	0.0	12.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	16.0	0.0
10	0.0	0.0	0.5	0.5	0.0	0.0	0.0	2.5	6.0	0.0	0.0	0.0
11	0.0	0.0	3.0	0.0	0.0	2.0	11.0	1.0	0.0	1.0	19.0	0.5
12	0.0	0.0	43.0	0.0	0.5	0.0	1.0	4.5	0.0	0.0	0.0	12.0
13	0.0	0.0	0.0	0.0	0.0	0.5	3.5	6.0	0.0	1.5	0.0	10.5
14	0.0	0.0	0.0	2.0	10.5	0.5	0.0	0.0	0.0	0.0	1.5	0.0
15	0.0	0.0	0.0	6.0	8.0	2.0	0.0	0.0	0.0	0.0	5.0	0.0
16	0.0	0.0	4.5	6.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	?	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	13.5	?	0.0	0.5	0.0	0.0	24.0	1.5	21.5	0.0
19	0.0	0.0	0.0	?	0.0	0.0	9.5	7.0	0.0	0.0	9.5	0.0
20	0.0	0.0	0.0	?	0.0	0.0	0.0	0.0	4.5	3.0	2.0	0.0
21	0.0	0.0	0.0	?	1.0	0.0	0.5	0.0	0.0	0.0	5.5	0.0
22	2.0	16.5	0.0	?	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.5
23	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	13.5	9.0	5.0	0.0
24	8.5	0.0	16.5	0.0	0.0	0.0	0.0	0.0	10.5	0.0	21.5	16.5
25	1.0	0.0	0.0	0.4	0.0	0.0	0.0	6.5	8.5	1.0	3.5	4.5
26	0.0	0.0	17.0	0.9	0.5	2.0	0.0	13.5	3.5	13.5	0.0	0.0
27	0.0	0.0	0.0	0.9	12.0	0.0	62.5	0.0	0.0	9.5	0.0	16.0
28	0.0	0.0	0.0	0.9	0.0	0.0	2.5	36.0	3.5	19.5	0.0	41.0
29	0.0	0.0	0.0	0.8	0.5	0.0	0.0	0.0	5.5	2.0	0.0	0.5
30	0.0		0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0		21.0		0.0		0.0	0.0		0.0		0.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	202.1	143.4	112.1	276.8	89.7	51.6	48.4	73.0	132.5	211.5	123.0	164.5	1628.6
Max	46.8	30.0	37.4	43.8	31.6	32.4	13.1	27.5	44.5	40.5	41.5	46.9	46.9
NO>0.0	21	12	12	22	12	5	11	12	15	21	19	12	174

Daily totals Year 2002 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	37.0	0.5	4.7	?	1.5	26.5	0.0	0.0	46.0	0.0
2	0.0	0.0	16.5	0.0	6.3	?	0.0	1.5	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	?	0.0	0.0	31.0	1.2	15.0	2.5
4	0.0	0.0	0.0	7.9	0.5	?	0.0	0.0	2.5	0.0	0.0	0.0
5	0.0	0.0	0.0	1.5	48.5	0.0	0.0	0.0	0.5	43.2	15.5	49.5
6	4.3	0.0	0.0	3.5	10.8	0.0	0.0	5.0	0.5	7.5	0.0	0.0
7	0.0	0.0	0.0	44.1	0.9	0.5	0.0	0.5	2.0	13.9	0.0	1.0
8	0.0	0.0	0.0	0.0	4.8	21.0	0.0	0.0	9.5	33.1	2.0	0.5
9	0.0	0.0	3.0	2.8	2.6	0.0	0.0	0.0	2.5	0.0	3.5	0.0
10	0.0	0.6	0.0	0.6	0.0	12.5	0.0	0.0	13.5	0.0	0.5	3.0
11	0.0	?	0.0	0.0	0.0	39.5	0.0	0.0	0.0	14.9	9.5	0.0
12	4.1	0.0	0.0	0.0	0.0	3.0	6.6	27.0	0.0	26.3	0.0	19.0
13	0.5	0.0	0.0	0.0	0.0	1.5	7.3	0.0	2.5	0.0	0.0	7.5
14	0.5	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	5.0	0.0
15	0.0	0.0	3.5	7.4	0.0	0.5	0.0	0.0	0.0	5.9	6.0	0.0
16	0.0	0.0	0.0	25.1	18.7	0.0	0.0	0.0	15.5	0.2	1.5	1.5
17	4.1	5.0	4.0	22.9	0.5	0.0	10.8	0.0	4.5	48.5	12.5	40.0
18	0.0	0.0	0.0	15.9	0.0	0.0	5.8	0.0	0.5	4.5	29.5	14.0
19	16.9	0.0	1.0	0.0	0.0	0.0	2.9	0.0	5.5	0.0	0.0	0.0
20	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	2.0	0.0	3.0	20.0
21	1.9	1.5	0.0	0.0	0.0	0.0	6.7	0.0	11.0	0.3	0.0	15.5
22	5.9	2.5	3.0	0.0	0.0	0.0	1.4	0.0	11.5	0.0	0.0	0.0
23	0.7	0.0	2.5	25.6	0.0	0.0	?	11.5	0.0	0.0	45.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	19.5	0.0	8.5	0.0
25	0.0	0.0	0.0	32.3	28.3	0.0	15.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.5	11.0	29.1	1.3	0.0	5.0	0.0	40.0	1.8	8.5	0.0
27	0.0	0.0	0.5	22.6	0.0	6.0	0.0	10.5	3.5	0.0	0.0	9.0
28	0.0	17.0	0.0	35.9	?	0.0	27.0	0.0	2.5	2.0	0.0	0.0
29	0.0		4.5	35.8	?	0.5	4.0	12.0	1.0	?	0.0	0.0
30	0.0		0.0	12.0	?	6.0	0.0	13.5	0.0	1.5	0.0	0.5
31	0.0		0.5		?		0.0	0.0		0.5		7.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

												0.0	0.0
Tot	38.9	27.1	99.0	328.7	127.9	91.0	94.0	108.5	181.5	206.2	211.5	190.5	1704.8
Max	16.9	17.0	37.0	44.1	48.5	39.5	27.0	27.0	40.0	48.5	46.0	49.5	49.5
NO>0.0	9	6	13	19	12	10	12	10	21	17	16	15	160

Daily totals Year 2003 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	16.5	14.5	0.0	0.0	17.9	0.0	0.0	1.0	2.0	11.5	17.5	?	
2	4.0	13.0	0.0	0.0	2.6	0.0	0.0	2.5	0.5	3.5	76.0	?	
3	4.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	35.5	3.0	?	
4	0.0	0.0	0.0	1.4	24.2	0.0	0.0	0.0	0.0	24.5	?	?	
5	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	7.0	?	?	
6	0.0	0.0	0.0	0.0	?	7.5	0.0	0.0	0.0	1.0	?	?	
7	8.2	0.0	16.9	0.0	1.5	0.0	14.0	0.0	11.5	4.5	?	?	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	19.0	3.5	?	?	
9	0.0	0.0	27.3	4.7	38.0	1.5	0.0	0.0	1.5	0.5	?	?	
10	0.0	0.0	0.0	12.2	0.0	0.5	0.5	3.5	26.0	1.0	?	?	
11	0.0	4.3	0.0	47.1	22.5	19.5	1.0	0.0	0.5	0.5	?	?	
12	0.0	6.2	0.0	3.1	2.5	0.0	0.0	0.5	0.0	0.0	?	?	
13	0.0	1.8	0.0	9.7	0.0	1.0	0.0	16.0	0.0	1.5	?	?	
14	0.0	0.0	0.0	0.0	0.5	6.0	0.0	0.5	1.0	0.0	?	?	
15	1.7	6.6	0.0	0.0	0.5	0.0	0.0	14.0	11.0	3.0	?	?	
16	0.0	22.6	0.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	?	?	
17	0.0	30.1	4.8	0.0	0.0	25.0	1.0	8.5	0.0	0.0	?	?	
18	7.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	27.0	0.0	?	?	
19	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	7.0	57.0	?	?	
20	2.2	5.4	18.0	9.4	0.0	0.0	0.0	0.0	0.5	31.0	?	?	
21	0.0	0.0	0.0	1.5	3.0	0.0	0.0	0.0	1.0	18.5	?	?	
22	0.0	0.0	0.6	0.0	3.0	2.0	0.0	0.0	18.0	3.5	?	?	
23	26.4	0.4	0.0	0.0	0.0	0.0	12.0	23.0	0.5	2.0	?	?	
24	0.6	0.0	0.6	0.0	0.0	17.5	0.0	0.0	0.5	24.0	?	?	
25	0.0	0.0	3.8	0.0	3.5	25.0	0.0	0.0	1.5	7.0	?	?	
26	1.2	0.0	20.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	?	?	
27	0.0	0.0	0.0	0.0	0.0	0.5	0.5	8.5	8.0	7.5	?	?	
28	0.0	0.0	15.2	0.0	0.0	3.5	1.0	0.0	0.0	0.0	?	?	
29	0.0		0.0	0.0	0.0	0.0	7.0	1.5	0.5	4.0	?	?	
30	0.0		10.4	17.7	0.0	0.0	0.0	0.0	3.0	0.0	?	?	
31	0.0		0.0		0.0		0.0	0.0		11.0		?	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	?	0.0
Tot	71.9	104.9	117.8	133.8	120.7	109.5	53.0	81.5	140.5	263.0	96.5	?	1293.1
Max	26.4	30.1	27.3	47.1	38.0	25.0	16.0	23.0	27.0	57.0	76.0	?	76.0
NO>0.0	11	10	12	12	13	12	9	13	20	23	3	0	138

Daily totals Year 2004 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0.0	0.0	0.0	19.0	2.5	11.5	0.0	19.1	0.0	0.0	53.2	0.0	
2	0.0	17.5	?	8.0	17.0	1.1	0.0	0.0	3.0	2.4	0.0	0.0	
3	0.0	0.0	?	0.0	1.5	8.0	4.4	0.0	0.6	2.9	7.3	0.0	
4	?	0.0	0.5	0.5	0.5	0.0	6.2	0.0	4.8	0.0	0.0	0.0	
5	?	119.0	24.0	0.5	37.0	2.2	14.0	0.0	0.0	0.0	6.0	1.3	
6	0.0	0.0	0.0	11.0	6.5	25.7	15.6	0.0	3.1	0.0	19.6	0.1	
7	0.0	0.0	0.0	0.0	0.5	0.0	22.0	0.0	0.0	7.2	0.5	2.7	
8	0.0	0.0	1.0	1.5	0.0	0.0	27.8	0.0	14.8	6.0	0.0	0.0	
9	0.0	39.2	0.5	0.0	0.0	0.0	13.0	0.0	0.4	15.3	5.7	1.6	
10	8.0	0.0	18.0	5.5	0.5	0.0	3.9	0.0	15.1	0.5	6.7	48.7	
11	0.0	0.0	1.5	56.5	0.0	0.0	0.0	0.0	3.8	2.8	0.0	0.0	
12	0.0	0.0	39.0	0.0	0.0	0.0	0.0	14.9	0.9	8.1	16.4	0.0	
13	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	8.5	2.0	33.1	0.0	
14	0.0	0.0	0.0	0.0	0.0	0.0	7.5	12.9	6.0	0.8	1.9	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	1.4	26.7	2.8	0.0	15.2	0.0	
16	0.0	0.0	0.0	1.5	0.0	0.0	52.2	0.0	0.4	0.0	0.0	0.8	
17	0.0	0.0	0.0	53.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
18	2.5	40.1	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
19	0.5	0.6	0.0	0.0	0.0	0.0	1.0	0.0	24.4	8.7	0.0	0.0	
20	0.0	25.2	0.0	0.0	0.0	0.0	1.1	0.0	6.4	1.7	7.9	0.0	
21	0.0	23.8	1.5	3.0	12.0	0.0	0.0	0.0	8.6	25.4	2.6	0.0	
22	0.0	26.5	0.0	11.0	0.0	0.0	0.2	0.0	4.5	60.0	0.0	0.0	
23	0.0	0.0	0.5	12.0	0.5	0.0	0.4	0.0	83.1	0.0	0.0	0.7	
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	2.9	1.3	0.0	
25	0.0	0.0	0.0	1.0	0.0	16.4	0.0	0.7	7.5	0.5	0.9	7.4	
26	0.0	0.0	3.0	0.0	0.0	2.5	0.0	0.0	24.1	3.7	0.0	0.0	
27	0.0	19.9	0.0	38.5	9.5	5.4	0.0	0.0	3.1	0.0	15.6	0.0	
28	42.0	0.0	3.5	1.5	0.0	15.9	4.2	0.0	5.5	0.6	4.0	0.0	
29	77.0	0.0	0.0	0.0	12.5	0.4	0.0	4.5	18.0	2.2	0.0	11.3	
30	1.0		0.0	5.5	0.0	1.1	11.1	0.0	3.5	0.0	0.0	?	
31	2.0		0.0		0.0		0.0	0.0		0.0		?	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Daily totals Year 2005 site 4708084 IBU BEKALAN TALANG at KUALA KANGSAR, PERAK
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	0.0	0.0	1.0	8.0	8.0	0.0	0.0	0.0	18.5	?	39.5
2	?	0.0	4.0	0.0	0.5	6.0	0.0	0.0	0.0	0.0	?	0.0
3	0.0	16.0	0.0	4.0	0.0	0.0	0.0	3.5	0.0	?	?	0.0
4	0.0	15.0	0.0	4.5	0.0	8.0	0.0	0.0	13.5	?	?	19.5
5	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	?	?	7.0
6	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	?	?	0.0
7	0.0	0.0	2.0	0.0	98.5	0.5	0.0	0.0	2.5	?	?	0.0
8	0.0	0.0	0.0	19.5	9.5	0.0	0.0	0.0	0.5	?	?	0.0
9	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	?	1.0	2.0
10	0.0	0.0	0.0	0.5	2.5	0.0	0.0	0.0	0.0	?	17.5	0.0
11	2.0	0.0	0.0	20.0	0.0	53.5	5.5	5.5	0.0	?	0.0	9.0
12	0.5	0.0	0.0	5.0	3.5	9.0	17.5	0.0	0.0	?	1.0	17.5
13	0.0	22.5	2.0	0.0	11.5	0.0	1.5	0.0	0.0	?	0.0	5.0
14	0.0	3.0	0.5	0.0	17.5	3.5	25.0	3.5	0.0	?	1.5	1.0
15	0.0	0.0	6.0	5.5	1.0	2.0	11.5	0.0	0.0	?	0.5	0.0
16	0.0	5.0	0.0	6.0	0.0	0.0	0.0	15.5	0.0	?	6.0	38.5
17	0.0	1.5	0.5	0.0	0.0	1.0	1.5	0.0	10.0	?	0.0	31.0
18	0.0	0.5	0.0	12.0	0.0	0.0	3.5	0.0	6.5	?	2.5	0.0
19	0.0	0.5	0.0	0.0	0.0	0.5	0.0	4.5	8.0	?	29.0	0.0
20	0.0	0.0	0.0	0.0	0.0	17.5	0.0	2.0	0.0	?	0.0	2.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	?	0.5	0.0
22	0.0	0.0	0.0	0.0	0.0	0.5	0.0	10.5	0.5	?	5.0	0.0
23	3.5	0.0	0.0	6.0	0.5	0.0	0.0	1.5	0.5	?	0.5	0.0
24	0.0	0.0	0.0	0.0	3.0	0.0	0.0	4.0	1.0	?	5.0	0.5
25	0.0	0.0	5.5	0.0	0.5	0.0	0.0	0.0	0.0	?	0.0	5.5
26	0.0	25.0	13.5	0.0	0.0	0.0	0.0	8.0	0.0	?	0.5	0.0
27	0.0	9.0	0.5	15.5	7.5	0.0	0.0	3.0	0.0	?	4.0	0.5
28	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	2.0	?	12.5	0.5
29	0.0		1.5	0.0	17.5	0.0	0.0	0.0	12.0	?	0.0	0.0
30	0.0		14.0	0.0	0.0	0.0	0.0	0.0	0.0	?	40.5	0.0
31	0.0		2.5		0.0		0.0	0.5		?		0.5
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

R factor

Total rainfall during 1991 until 1995:

Table 1: Monthly total rainfall from 1991 until 1995

	1991	1992	1993	1994	1995
January	88.0	50.0	194.5	99.5	105.0
February	133.0	135.5	87.5	136.5	94.0
March	128.0	157.5	160.5	203.5	151.0
April	103.0	59.5	104.5	135.0	302.5
May	393.0	88.0	204.5	76.0	123.0
June	82.5	44.0	161.5	55.0	194.0
July	121.0	161.0	171.0	6.0	103.5
August	98.5	87.5	117.5	191.5	278.0
September	63.0	81.0	154.5	123.5	232.0
October	109.5	115.5	234.0	133.0	170.0
November	158.0	118.5	323.0	228.0	215.0
December	66.0	125.5	301.5	107.5	134.5
Total per year(mm)	1543.5	1223.5	2214.5	1495.0	2102.5

Total annual rainfall 1991-1995

= total rainfall 1991 + total rainfall 1992 + total rainfall 1993 + total rainfall 1994 + total rainfall 1995

= 1543.5 + 1223.5 + 2214.5 + 1495.0 + 2102.5

= 7634.7 mm

Mean annual rainfall, P = Total annual rainfall 1991-1995 / Year duration

= 7634.7 / 5

= **1526.94 mm**

R factor = P/2

= 1526.94 / 2

= 763.47

<u>Total rainfall during 1996 until 2000:</u>

Table 2: Monthly total rainfall from 1996 until 2000

	1996	**1997**	**1998**	**1999**	**2000**
January	187.5	35.5	170.0	203.2	-
February	129.5	178.5	88.5	121.2	198.3
March	154.7	28.0	50.5	91.5	346.4
April	113.4	197.5	134.5	124.8	152.2
May	87.5	70.5	143.5	48.8	65.4
June	150.0	101.0	115.5	103.1	104.1
July	87.5	152.5	124.0	81.0	109.3
August	292.0	70.0	222.8	134.5	59.1
September	44.0	149.0	269.1	325.0	195.2
October	266.5	237.0	192.7	252.4	225.5
November	225.0	235.5	248.8	31.0	135.3
December	162.0	117.5	95.8	1516.5	241.8
Total per year (mm)	1899.6	1572.5	1855.7	3033.0	1832.6

Total annual rainfall 1996-2000

= total rainfall 1996 + total rainfall 1997 + total rainfall 1998 + total rainfall 1999 + total rainfall 2000

= 1899.6 + 1572.5 + 1855.7 + 3033.0 + 1832.6

= **10193.4 mm**

Mean annual rainfall, P = $\dfrac{\text{Total annual rainfall 1996-2000}}{\text{Year duration}}$

= $\dfrac{10193.4}{5}$

= **2038.68 mm**

ʅ factor = P/2

= 2038.68 / 2

= **1019.34**

Total rainfall during 2001 until 2005:

Table 3: Monthly total rainfall from 2001 until 2005

	2001	**2002**	**2003**	**2004**	**2005**
January	202.1	38.9	71.9	133.0	6.0
February	143.4	27.1	104.9	311.8	98.0
March	112.1	99.0	117.8	93.0	52.5
April	276.8	328.7	133.8	235.0	109.0
May	89.7	127.9	120.7	100.5	182.0
June	51.6	91.0	109.5	90.2	110.5
July	48.4	94.0	53.0	186.5	66.0
August	73.0	108.5	81.5	78.8	81.0
September	132.5	181.5	140.5	265.7	57.0
October	211.5	206.2	263.0	153.7	18.5
November	123.0	211.5	96.5	197.9	127.5
December	164.5	190.5	-	74.6	179.5
Total per year (mm)	1628.6	1704.8	1293.1	1920.7	1087.5

Total annual rainfall 2001-2005

= total rainfall 2001 + total rainfall 2002 + total rainfall 2003+ total rainfall 2004 + total rainfall 2005

= 1628.6 + 1704.8+ 1293.1 + 1920.7 + 1087.5

= **8579 mm**

Mean annual rainfall, P = Total annual rainfall 2001-2005 / Year duration

= 8579 / 5

= **1715.8 mm**

R factor = P/2

= 1715.8 / 2

= **857.9**

Table 4: Summary of R factor

Year	1991-1995	1996-2000	2001-2006
Total Annual Rainfall (mm)	7634.7	10193.4	8579.0
Mean Annual Rainfall (mm)	1526.94	2038.68	1715.8
R factor	763.5	1019.34	857.9

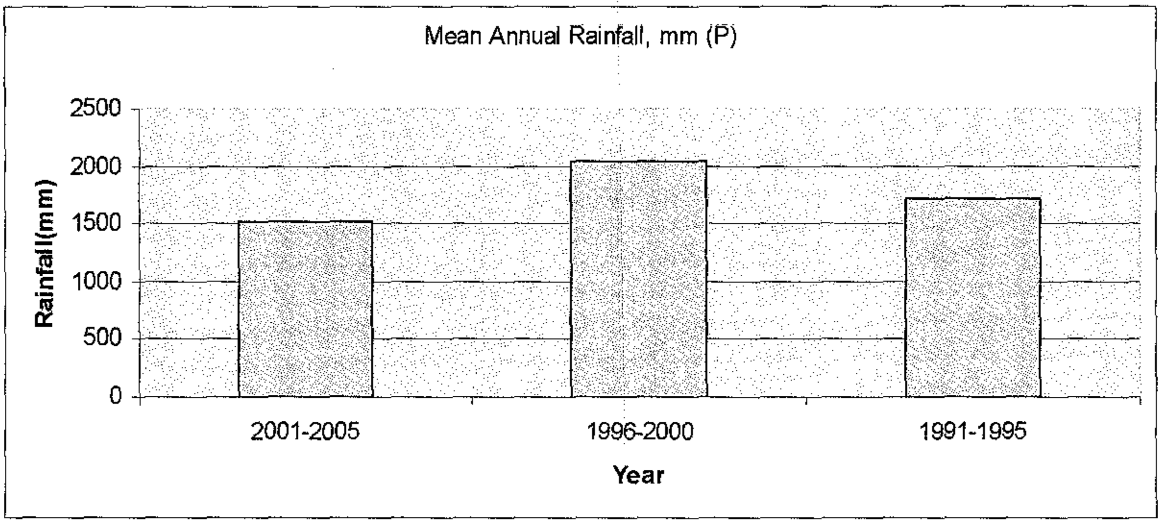


Figure 1: Mean annual rainfall, P

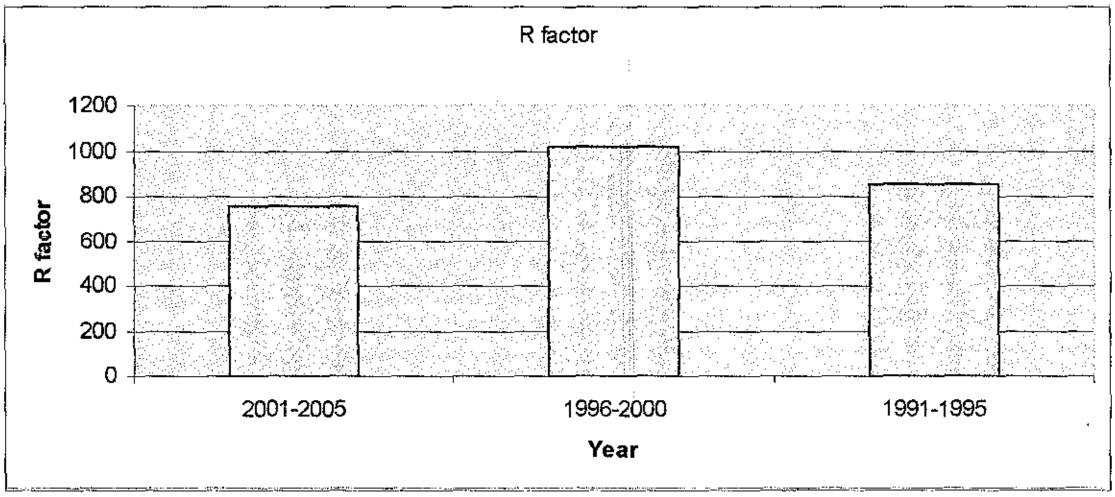


Figure 2: R factor

APPENDIX C

K factor

Procedure in taking soil samples:

1. Four samples of soil were taken from each selected slope.
2. Samples were taken to laboratory to determine types of soil to get the K factor.
3. Data obtained from particle distribution test.

Determination of Particle Distribution:

Objective:

To determine the size distribution of soil using the dry sieving method.

Apparatus:

a) Test sizes having the following aperture sizes:

2mm, 1.18mm, 600μm, 425μm, 300μm, 212μm, 150μm, 63μm, lid and receiver.

b) Electronic balances

c) Riffle box

d) Drying oven

e) Tray

f) Scoop

g) Sieve brushes

h) Mechanical sieve shaker

Procedure:

1. Weight the oven dried sample to 500g (m1),

2. Stack test sieves on the mechanical shaker with the largest size test sieve appropriate to the maximum size of material present at the bottom of the stack followed by the smaller size test sieve and a receiver at the bottom of the stack.
3. Place the sample on the top sieve and cover the sieve with a lid. Agitate the test sieves on the mechanical sieve shaker for 5 minute. Weight the amount retained on each of the test sieves to 500g.

Calculation and Final Results:

1. Calculate the percentage by mass of material retained on each test sieve.

2. Calculate the cumulative percentage (by mass of total sample passing each of the sieves.

3. Report the results as in table, to the nearest 1%, the percentage by mass passing each of the sieves used.

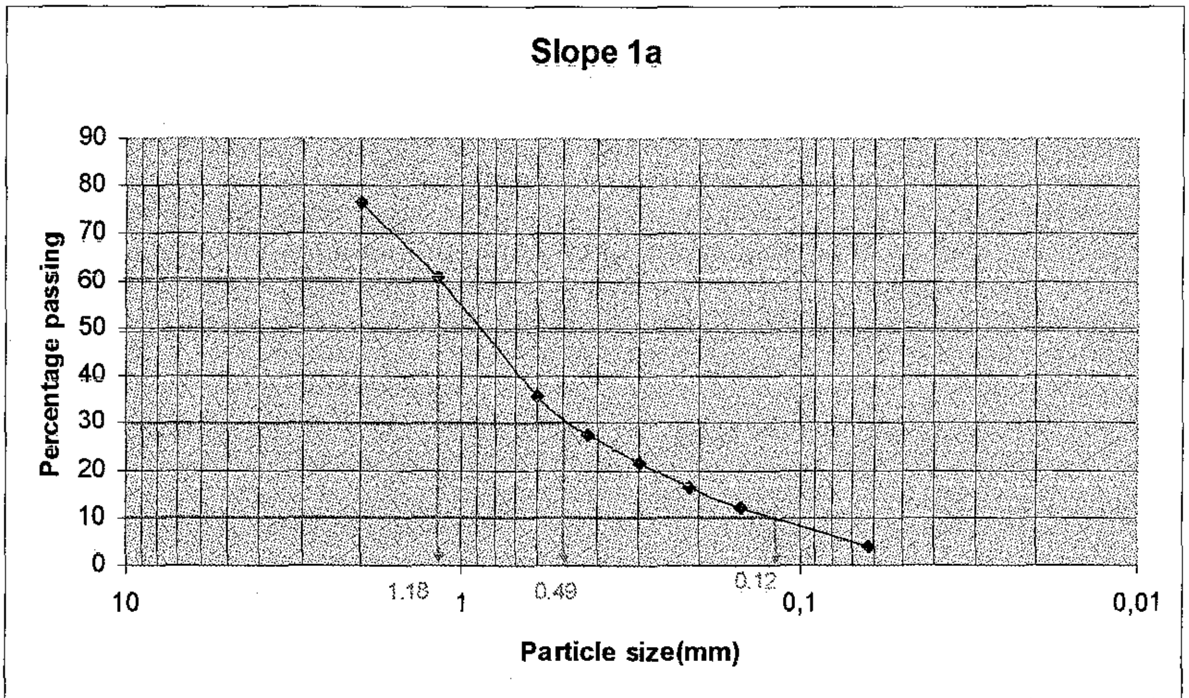
4. Express the results obtained on a semi-logarithmic chart.

Results obtained:

1) Slope 1

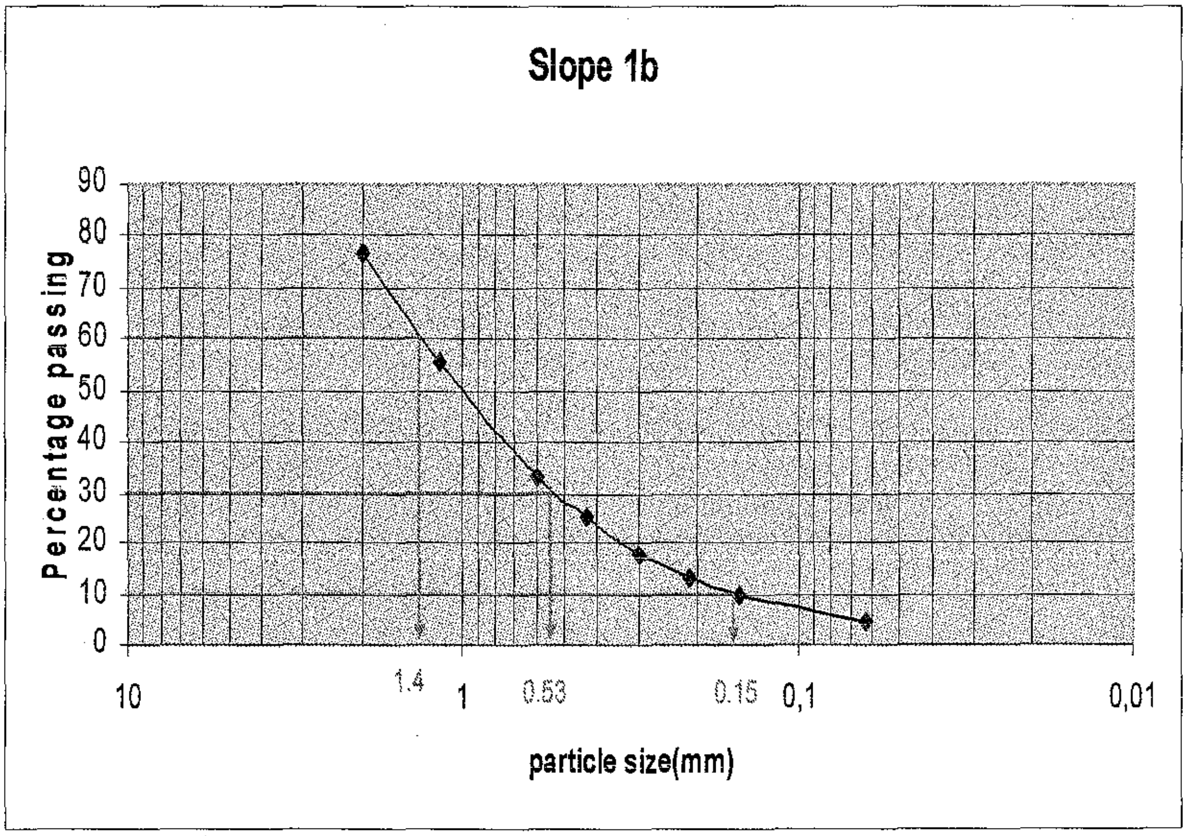
Slope 1a:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.505	0.116	0.116	76.5
1.18	0.426	0.505	0.079	0.195	60.5
0.6	0.405	0.527	0.122	0.317	35.8
0.425	0.296	0.336	0.040	0.357	27.7
0.3	0.286	0.317	0.031	0.388	21.5
0.212	0.340	0.365	0.025	0.413	16.4
0.15	0.276	0.297	0.021	0.434	12.2
0.063	0.327	0.367	0.040	0.474	4.1
Pan	0.246	0.266	0.020	0.494	0.0
			0.494		



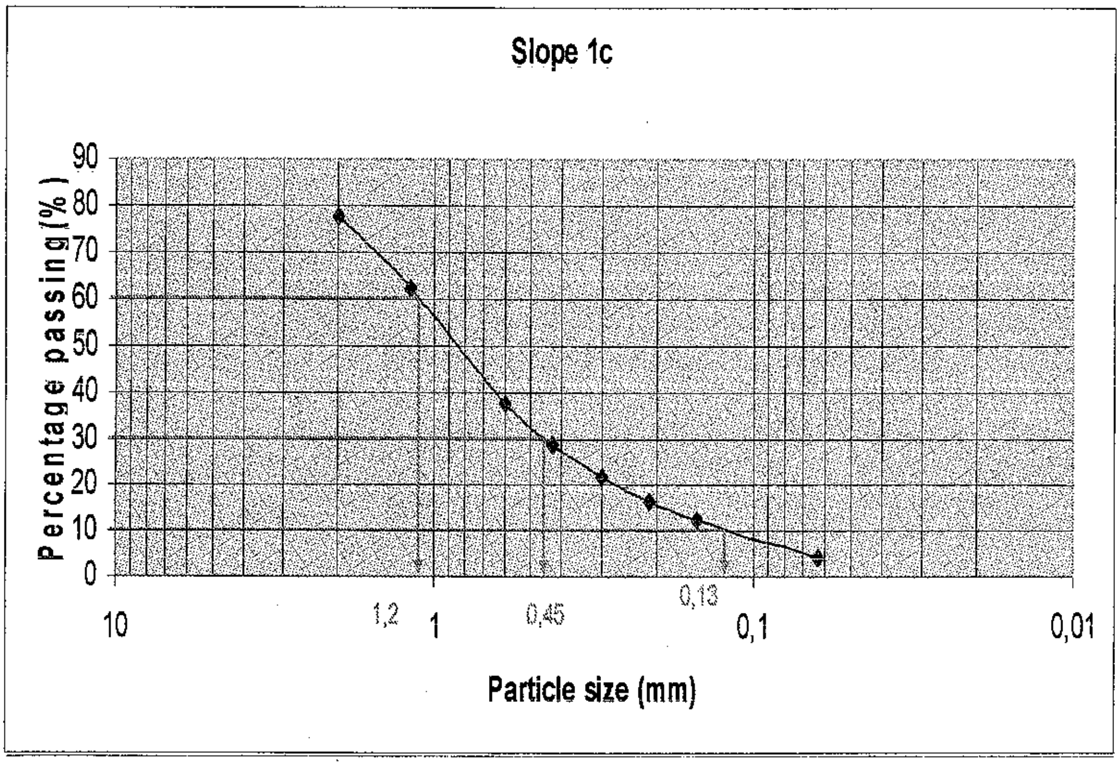
Slope 1b:

Initial dry mass, m1	500 g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.380	0.497	0.117	0.117	76.6
1,18	0.354	0.460	0106	0.223	55.4
0.6	0.330	0.440	0.110	0.333	33.4
0.425	0.371	0.413	0.042	0.375	25.0
0.3	0.358	0.394	0.036	0.411	17.8
0.212	0.276	0.299	0.023	0.434	13.2
0.15	0.311	0.328	0.017	0.451	9.8
0.063	0.328	0.354	0.026	0.477	4.6
Pan	0.392	0.415	0.023	0.500	0
			0.500		



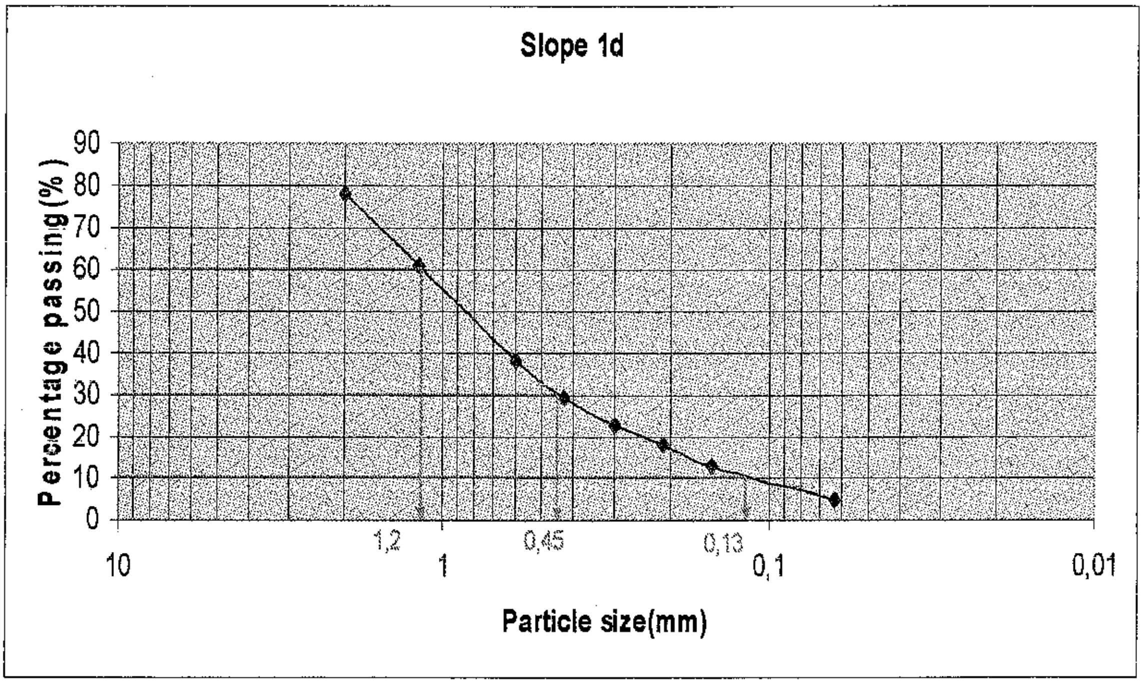
Slope 1c:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.389	0.500	0.111	0.111	77.6
1.18	0.426	0.500	0.074	0.185	62.6
0.6	0.405	0.529	0.124	0.309	37.6
0.425	0.296	0.340	0.044	0.353	28.7
0.3	0.286	0.320	0.034	0.387	21.8
0.212	0.340	0.367	0.027	0.414	16.4
0.15	0.276	0.296	0.020	0.434	12.3
0.063	0.327	0.368	0.041	0.475	4.0
Pan	0.246	0.266	0.020	0.495	0.0
			0.495		



Slope 1d:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.389	0.498	0.109	0.109	78.2
1.18	0.426	0.512	0.086	0.195	61.0
0.6	0.405	0.520	0.115	0.310	38.0
0.425	0.296	0.339	0.043	0.353	29.4
0.3	0.286	0.319	0.033	0.386	22.8
0.212	0.340	0.362	0.022	0.408	18.4
0.15	0.276	0.302	0.026	0.434	13.2
0.063	0.327	0.369	0.042	0.476	4.8
Pan	0.246	0.270	0.024	0.500	0.0
			0.500		



From curve:

Slope	**1a**	**1b**	**1c**	**1d**
D10	0.12	0.15	0.13	0.13
D30	0.49	0.53	0.45	0.45
D60	1.18	1.40	1.20	1.20
Cu	9.83	9.33	9.23	9.23
Cz	1.70	1.34	1.30	1.30

Percentages of gravel, sand, silt, and clay-size particle present:

1a	76.2	100		
			23.48	gravel
	2	76.52		
			72.47	sand
	0.063	4.05		
			4.05	silt and clay
	-	0		

1b	76.2	100		
			23.40	gravel
	2	76.6		
			72.00	sand
	0.063	4.6		
			4.60	silt and clay
	-	0		

1c	76.2	100		
			22.42	gravel
	2	77.58		
			73.54	sand
	0.063	4.04		
			4.04	silt and clay
	-	0		

1d	76.2	100		
			21.8	gravel
	2	78.2		
			73.4	sand
	0.063	4.8		
			4.80	silt and clay
	-	0		

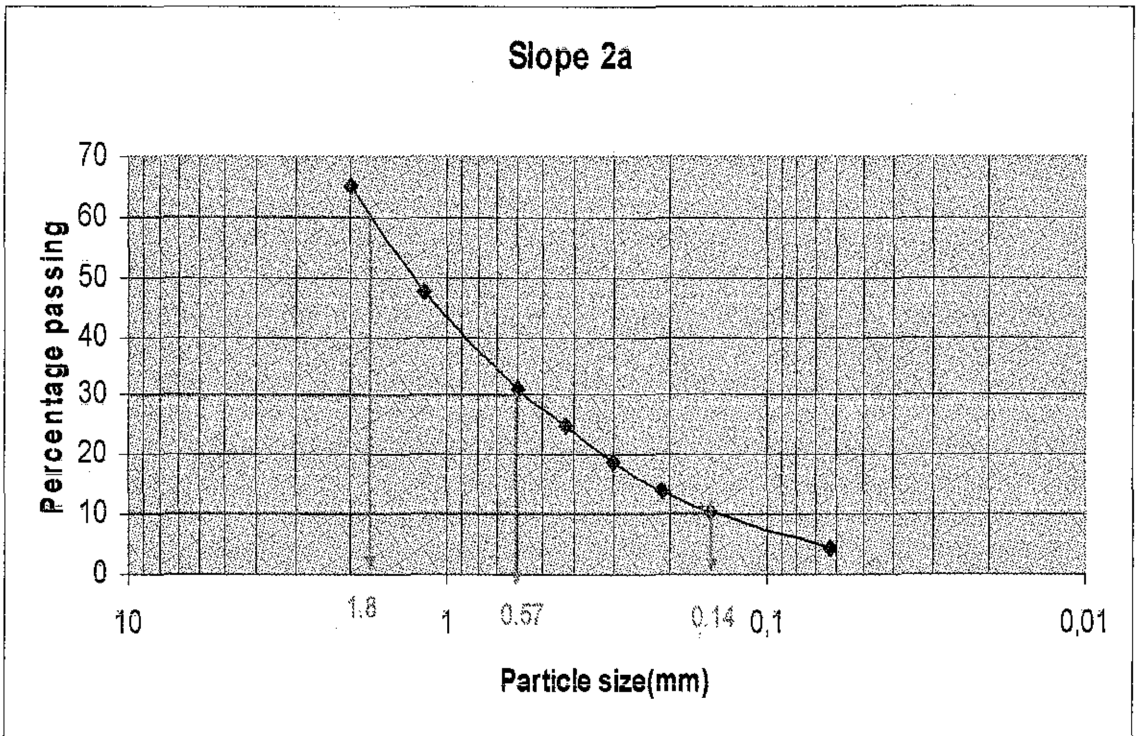
Points	Types of soil using United Classification System
1a	SW with 23.48% of gravel
1b	SW with 23.40% of gravel
1c	SW with 22.42% of gravel
1d	SW with 21.80% of gravel
Slope 1	SW with 22.78% of gravel

∴ **Slope 1 is well graded sand with 22.78% of gravel**

2) Slope 2

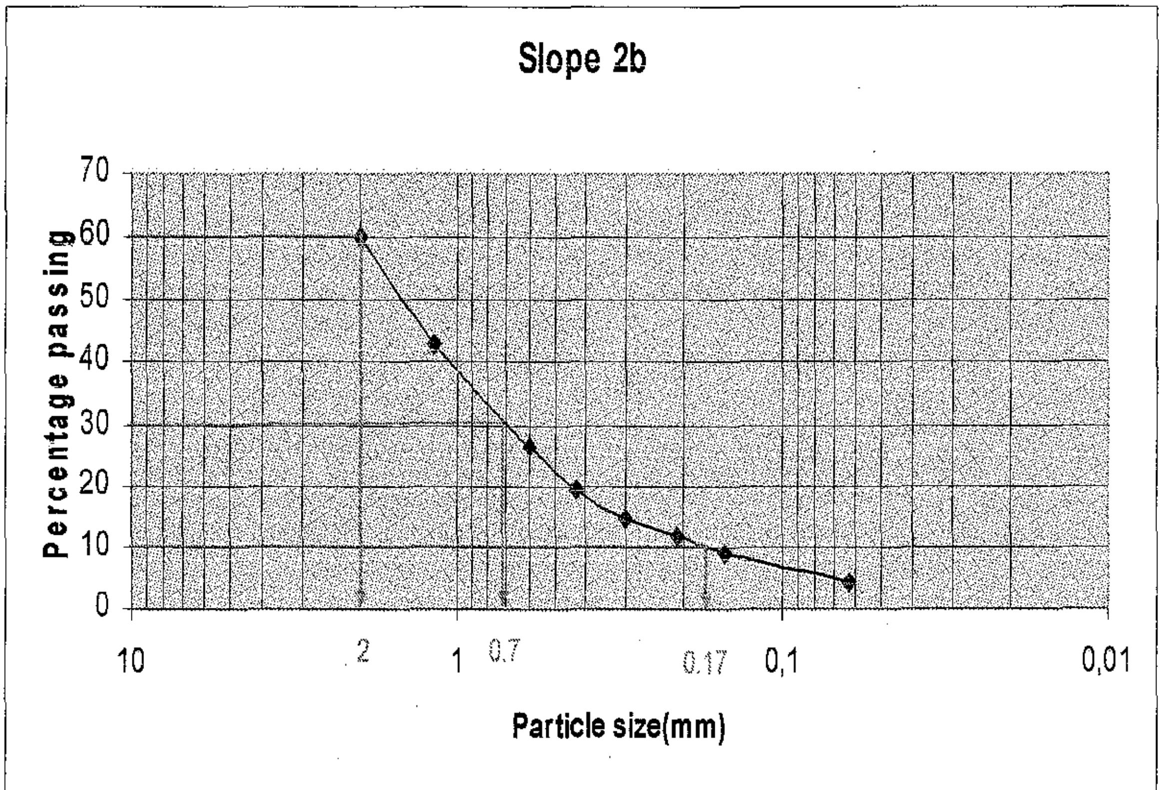
Slope 2a:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.381	0.554	0.173	0.173	65.40
1.18	0.435	0.524	0.089	0.262	47.60
0.6	0.406	0.488	0.082	0.344	31.20
0.425	0.371	0.403	0.032	0.376	24.80
0.3	0.355	0.385	0.030	0.406	18.80
0.212	0.276	0.299	0.023	0.429	14.20
0.15	0.269	0.287	0.018	0.447	10.60
0.063	0.327	0.358	0.031	0.478	4.40
Pan	0.392	0.414	0.022	0.500	0.00
			0.500		



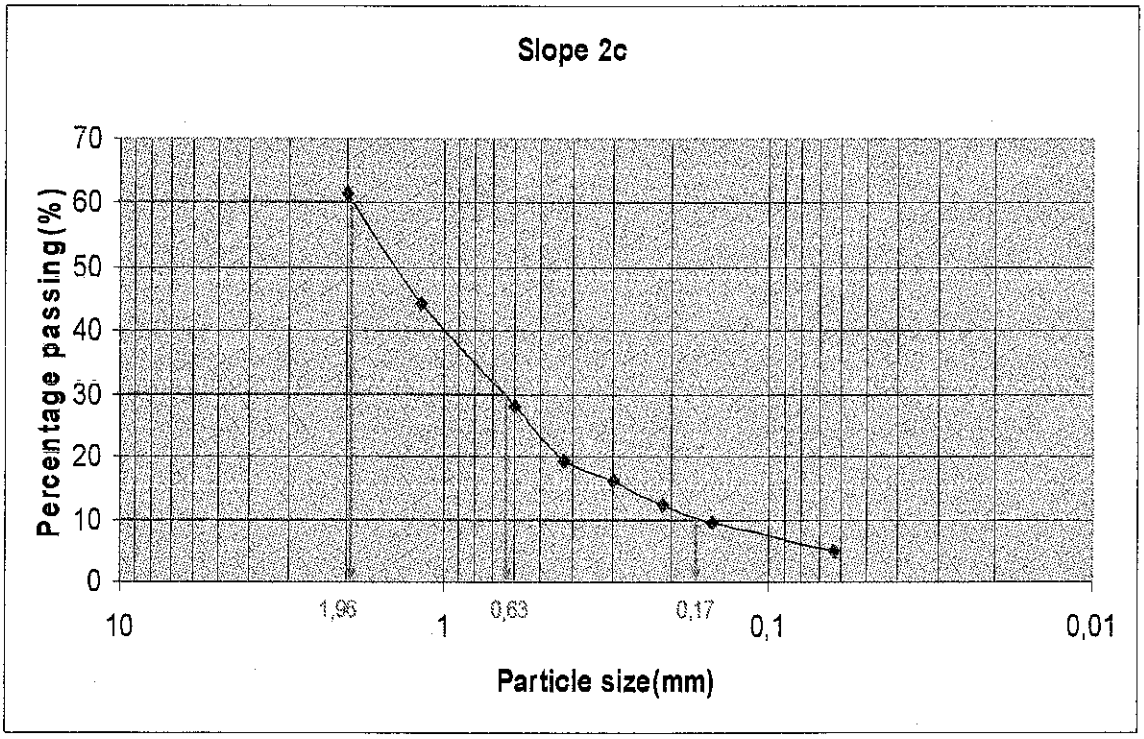
Slope 2b:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.587	0.198	0.198	60.24
1.18	0.426	0.512	0.086	0.284	42.97
0.6	0.330	0.412	0.082	0.366	26.51
0.425	0.296	0.332	0.036	0.402	19.28
0.3	0.286	0.308	0.022	0.424	14.86
0.212	0.340	0.356	0.016	0.440	11.65
0.15	0.276	0.290.	0.014	0.454	8.84
0.063	0.327	0.350	0.023	0.477	4.22
Pan	0.246	0.267	0.021	0.498	0.00
			0.498		



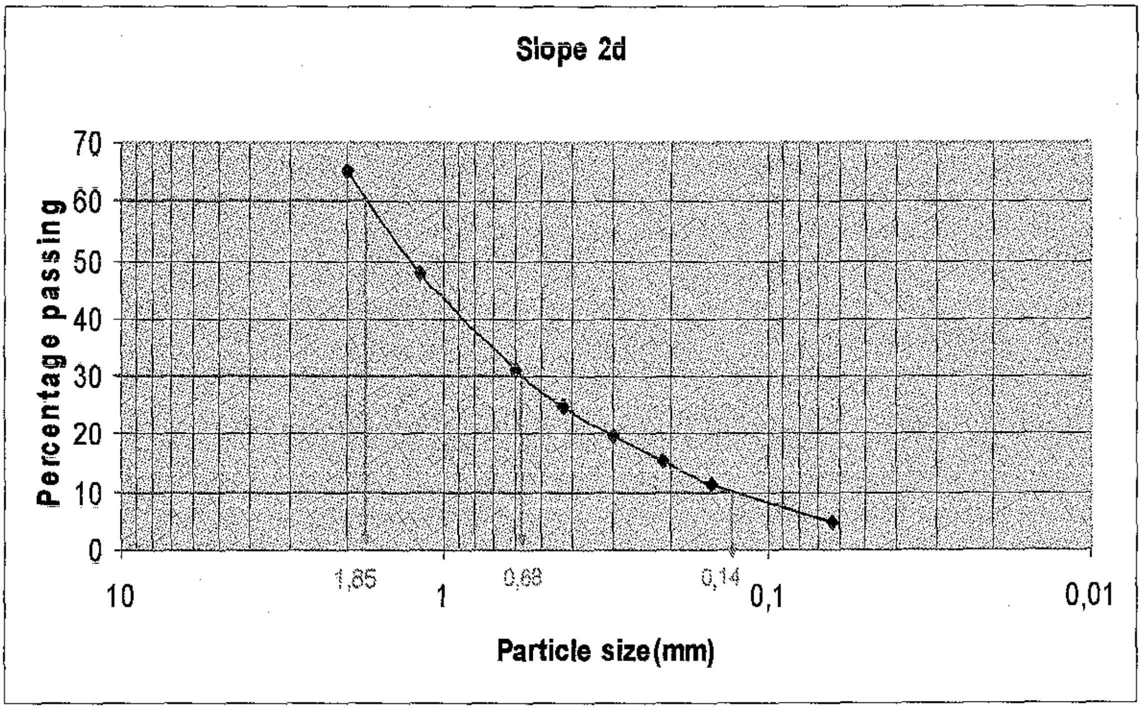
Slope 2c:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected(m)**		
2	0.389	0.580	0.191	0.191	61.65
1.18	0.426	0.512	0.086	0.277	44.38
0.6	0.330	0.411	0.081	0.358	28.11
0.425	0.296	0.339	0.043	0.401	19.48
0.3	0.286	0.303	0.017	0.418	16.06
0.212	0.340	0.358	0.018	0.436	12.45
0.15	0.276	0.291	0.015	0.451	9.44
0.063	0.327	0.350	0.023	0.474	4.82
Pan	0.246	0.270	0.024	0.498	0.00
			0.498		



Slope 2d:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.381	0.555	0.174	0.174	65.20
1.18	0.435	0.521	0.086	0.260	48.00
0.6	0.406	0.489	0.083	0.343	31.40
0.425	0.371	0.403	0.032	0.375	25.00
0.3	0.355	0.382	0.027	0.402	19.60
0.212	0.276	0.297	0.021	0.423	15.40
0.15	0.269	0.289	0.020	0.443	11.40
0.063	0.327	0.361	0.034	0.477	4.60
Pan	0.392	0.415	0.023	0.500	0.00
			0.50		



From curve:

	2a	2b	2c	2d
D10	0.14	0.17	0.17	0.14
D30	0.57	0.70	0.63	0.68
D60	1.80	2.00	1.96	1.85
Cu	12.86	11.76	11.53	13.21
Cz	1.29	1.44	1.19	1.79

Percentages of gravel, sand, silt, and clay-size particle present:

2a	76.2	100		
			34.60	gravel
	2	65.4		
			61.00	sand
	0.063	4.4		
			4.40	silt and clay
	-	0		

2b	76.2	100		
			39.76	gravel
	2	60.24		
			56.02	sand
	0.063	4.22		
			4.22	silt and clay
	-	0		

2c	76.2	100		
			22.42	gravel
	2	77.58		
			73.54	sand
	0.063	4.04		
			4.04	silt and clay
	-	0		

2d	76.2	100		
			21.80	gravel
	2	78.2		
			73.40	sand
	0.063	4.8		
			4.80	silt and clay
	-	0		

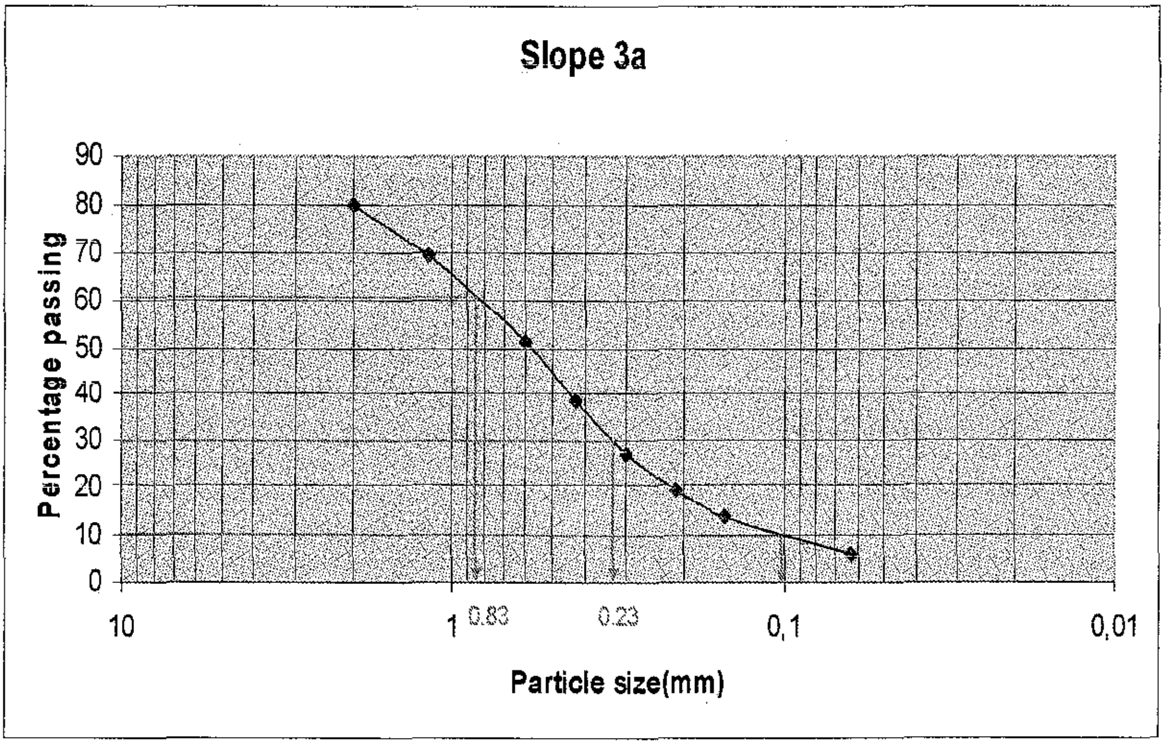
Points	Types of soil using United Classification System
2a	SW with 34.60% of gravel
2b	SW with 39.76% of gravel
2c	SW with 22.42% of gravel
2a	SW with 21.80% of gravel
Slope 2	SW with 29.65% of gravel

∵ Slope 2 is well graded sand with 29.65% of gravel

3) Slope 3

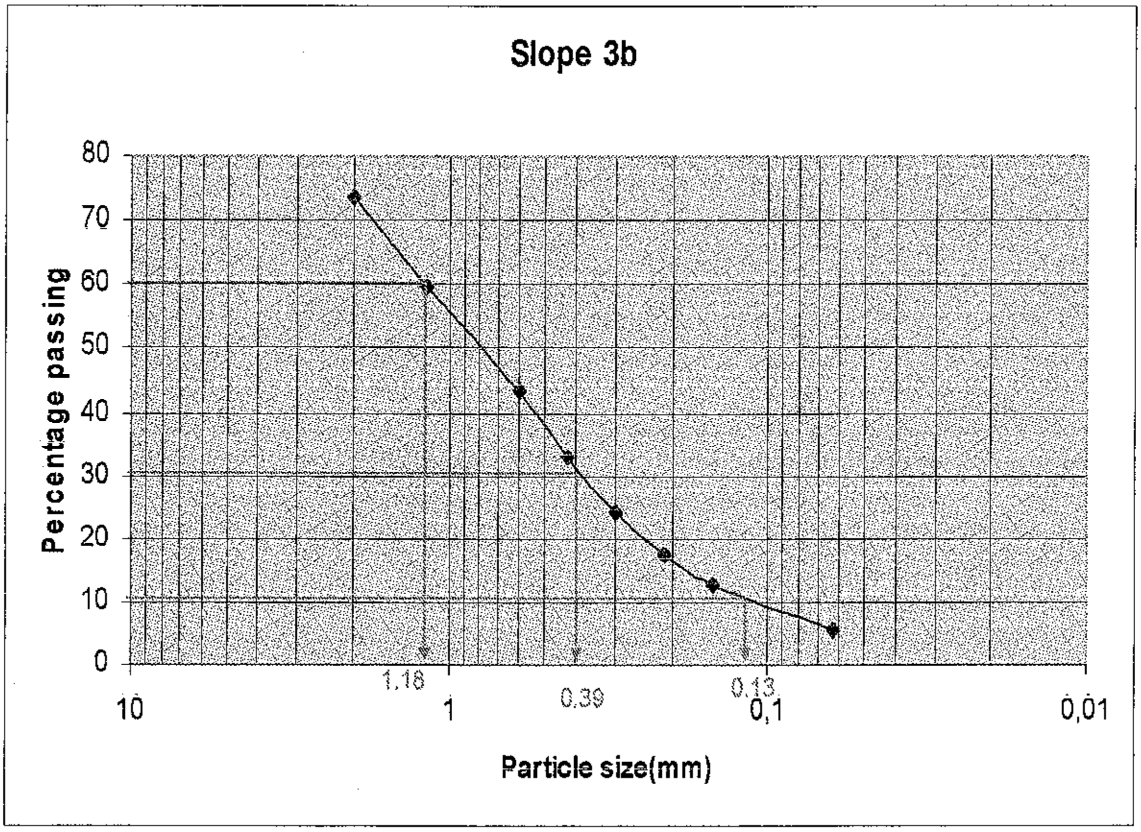
Slope 3a:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.488	0.099	0.099	80.08
1.18	0.426	0.479	0.053	0.152	69.42
0.6	0.330	0.419	0.089	0.241	51.51
0.425	0.296	0.369	0.073	0.314	36.82
0.3	0.286	0.343	0.057	0.371	25.35
0.212	0.340	0.379	0.039	0.410	17.51
0.15	0.276	0.304	0.028	0.438	11.87
0.063	0.327	0.367	0.040	0478	3.82
Pan	0.246	0.265	0.019	0497	0.00
			0.497		



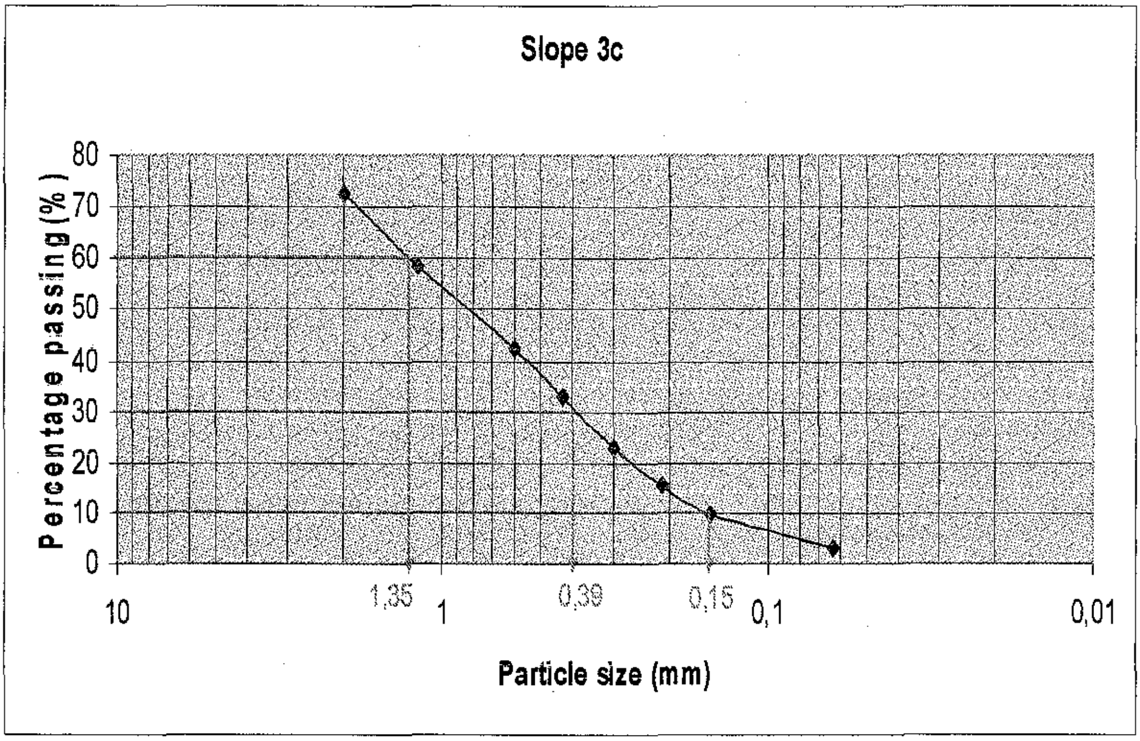
Slope 3b:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.389	0.52	0.131	0.131	73.80
1.18	0.426	0.496	0.070	0.201	59.80
0.6	0.330	0.413	0.083	0.284	43.20
0.425	0.296	0.346	0.050	0.334	33.20
0.3	0.286	0.341	0.055	0.389	22.20
0.212	0.340	0.373	0.033	0.422	15.60
0.15	0.276	0.301	0.025	0.447	10.60
0.063	0.327	0.363	0.036	0.483	3.40
Pan	0.246	0.263	0.017	0.500	0.00
			0.5		



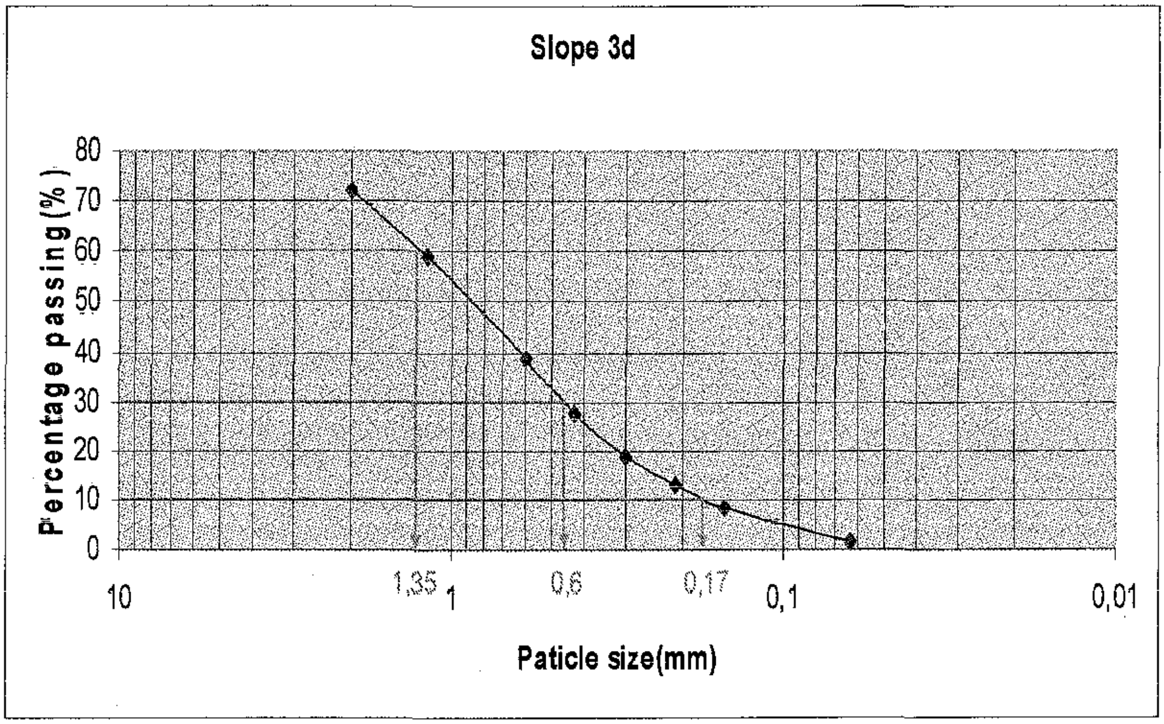
Slope 3c:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.523	0.134	0.134	72.76
1.18	0.426	0.495	0.069	0.203	58.74
0.6	0.330	0.410	0.080	0.283	42.48
0.425	0.296	0.344	0.048	0.331	32.72
0.3	0.286	0.333	0.047	0.378	23.17
0.212	0.340	0.376	0.036	0.414	15.85
0.15	0.276	0.304	0.028	0.442	10.16
0.063	0.327	0.362	0.035	0.477	3.05
Pan	0.246	0.261	0.015	0.492	0.00
			0.492		



Slope 3d:

Initial dry mass, m1	500g				
		Mass retained, g			
BS test sieve	Weight of sieve	Actual	Corrected (m)	Cumulative retained	Percent finer
2	0.389	0.526	0.137	0.137	72.21
1.18	0.426	0.492	0.066	0.203	58.82
0.6	0.330	0.429	0.099	0.302	38.74
0.425	0.296	0.351	0.055	0.357	27.59
0.3	0.286	0.329	0.043	0.400	18.86
0.212	0.340	0.369	0.029	0.429	12.98
0.15	0.276	0.299	0.023	0.452	8.32
0.063	0.327	0.36	0.033	0.485	1.62
Pan	0.246	0.254	0.008	0.493	0.00
			0.493		



From curve:

	3a	3b	3c	3d
D10	0.10	0.13	0.15	0.17
D30	0.23	0.39	0.39	0.60
D60	0.83	1.18	1.35	1.35
Cu	8.30	9.08	9.00	7.94
Cz	0.64	0.99	0.75	1.57

Percentages of gravel, sand, silt, and clay-size particle present:

3a	76.2	100
	2	8008
	0,063	3,05
	-	0

19.92	gravel
77.03	sand
3.05	silt and clay

3b	76.2	100
	2	73.80
	0.063	3.40
	-	0

26.20	gravel
70.40	sand
3.40	silt and clay

3c	76.2	100
	2	72.76
	0.063	3.05
	-	0

27.24	gravel
69.71	sand
3.05	silt and clay

3d	76.2	100
	2	72.21
	0.063	1.62
	-	0

27.79	gravel
70.59	sand
1.62	silt and clay

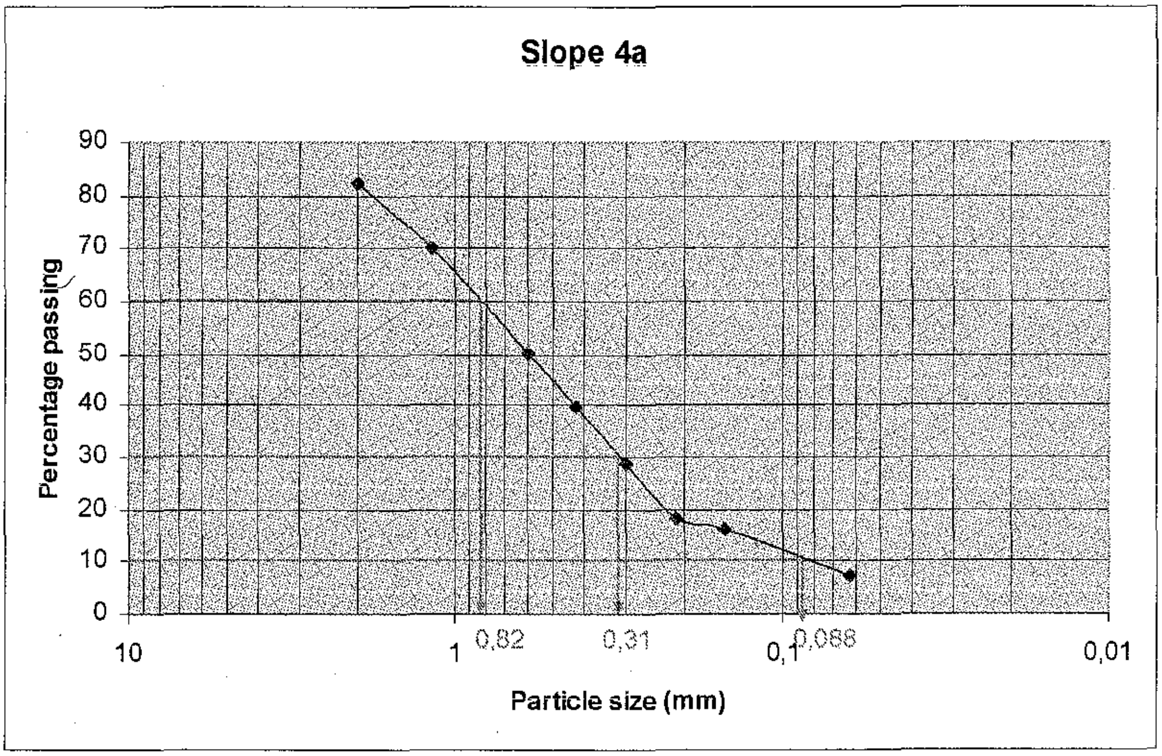
Points	Types of soil using United Classification System
3a	SP with 19.92% of gravel
3b	SP with 26.20% of gravel
3c	SP with 27.24% of gravel
3d	SW with 27.79% of gravel
Slope 3	SP with 25.29% of gravel

∵ Slope 3 is mostly poorly graded sand with 25.29% of gravel

4) Slope 4

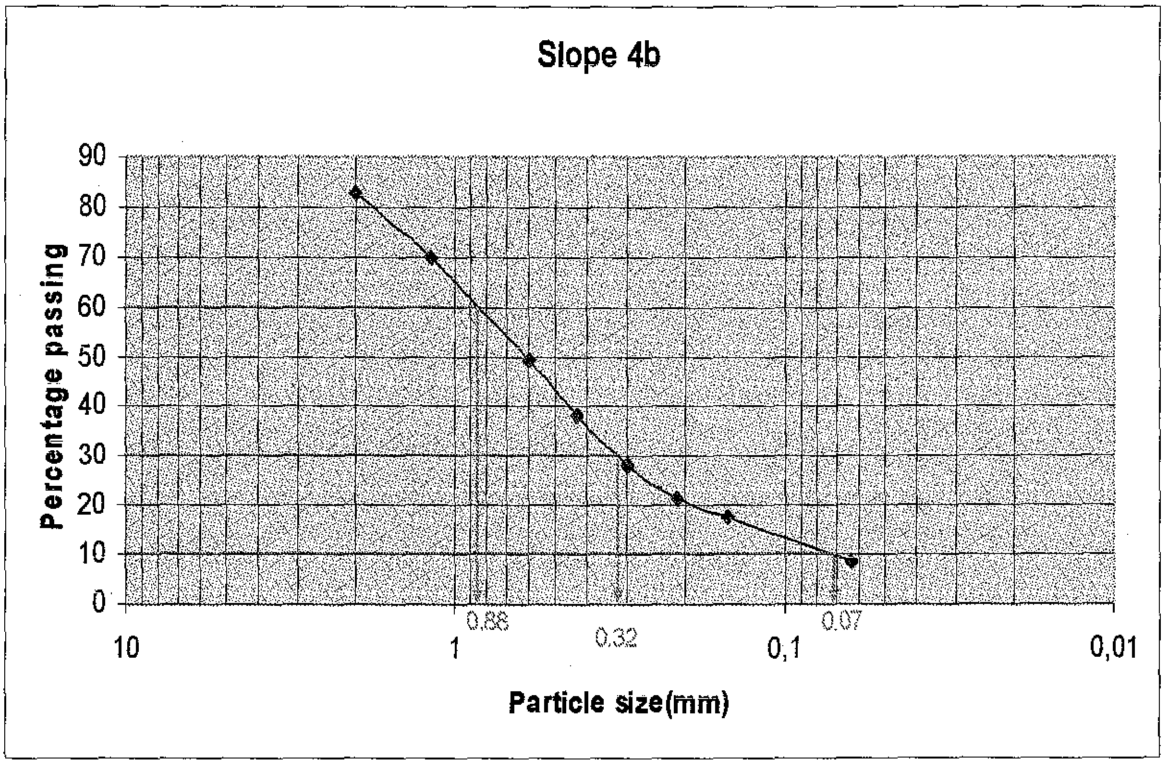
Slope 4a:

Initial dry mass, m1	500g				
		Mass retained, g			
BS test sieve	Weight of sieve	Actual	Corrected (m)	Cumulative retained	Percent finer
2	0.380	0.467	0.087	0.087	82.46
1.18	0.354	0.416	0.062	0.149	69.96
0.6	0.330	0.427	0.097	0.246	50.40
0.425	0.371	0.424	0.053	0.299	39.72
0.3	0.358	0.422	0.064	0.363	26.82
0.212	0.276	0.334	0.058	0.421	15.12
0.15	0.311	0.321	0.010	0.431	13.11
0.063	0.328	0.373	0.045	0.476	4.03
Pan	0.392	0.412	0.020	0.496	0.00
			0.496		



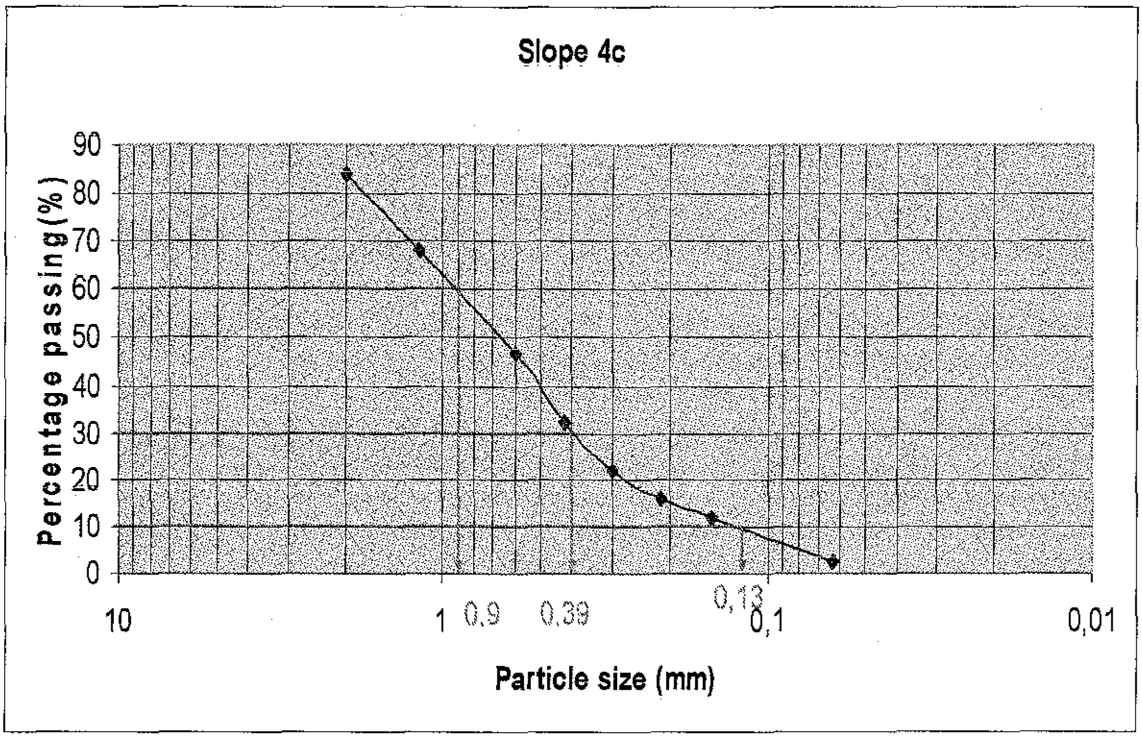
Slope 4b:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.380	0.464	0.084	0.084	83.03
1.18	0.354	0.420	0.066	0.150	69.70
0.6	0.330	0.442	0.112	0.262	47.07
0.425	0.371	0.435	0.064	0.326	34.14
0.3	0.358	0.417	0.059	0.385	22.22
0.212	0.276	0.319	0.043	0.428	13.54
0.15	0.311	0.34	0.029	0.457	7.68
0.063	0.328	0.354	0.026	0.483	2.42
Pan	0.392	0.404	0.012	0.495	0.00
			0.495		



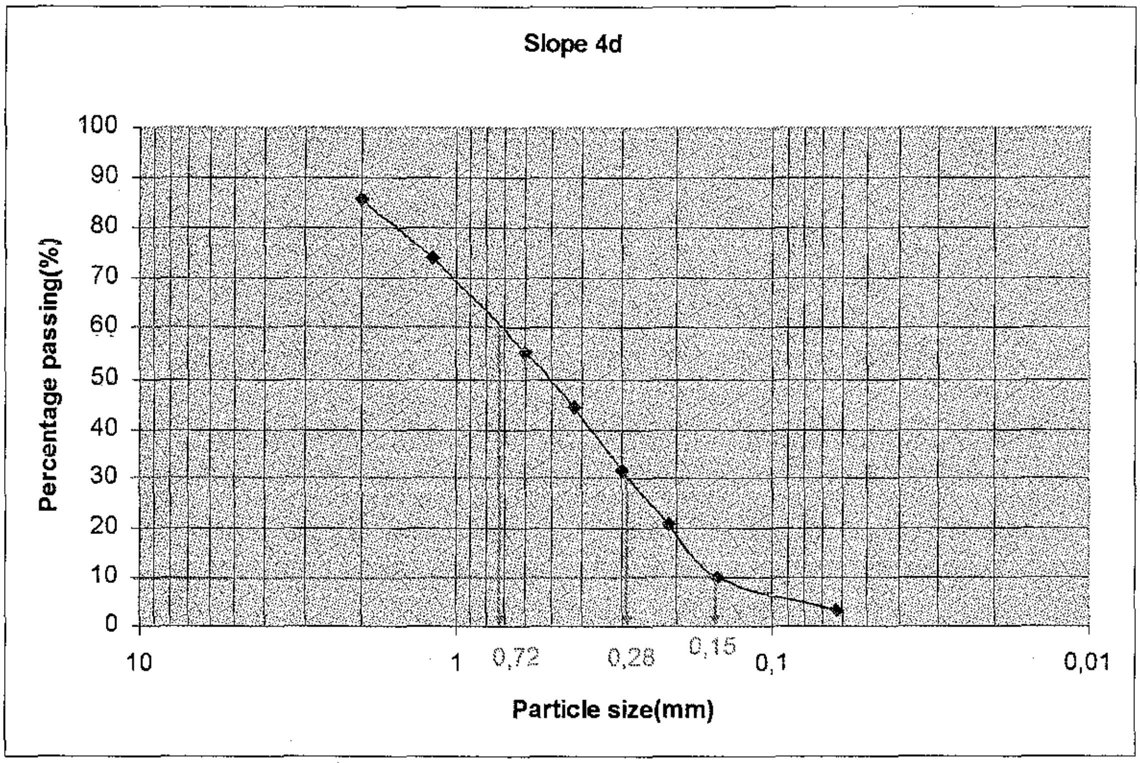
Slope 4c:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.380	0.460	0.080	0.080	83.87
1.18	0.354	0.432	0.078	0.158	68.15
0.6	0.330	0.437	0.107	0.265	46.57
0.425	0.371	0.441	0.070	0.335	32.46
0.3	0.358	0.411	0.053	0.388	21.77
0.212	0.276	0.305	0.029	0.417	15.93
0.15	0.311	0.331	0.020	0.437	11.90
0.063	0.328	0.375	0.047	0.484	2.42
Pan	0.392	0.404	0.012	0.496	0.00
			0.496		



Slope 4d:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.380	0.451	0.071	0.071	85.74
1.18	0.354	0.411	0.057	0.128	74.30
0.6	0.330	0.425	0.095	0.223	55.22
0.425	0.371	0.425	0.054	0.277	44.38
0.3	0.358	0.421	0.063	0.340	31.73
0.212	0.276	0.331	0.055	0.395	20.68
0.15	0.311	0.364	0.053	0.448	10.04
0.063	0.328	0.361	0.033	0.481	3.41
Pan	0.392	0.409	0.017	0.498	0.00
			0.498		



From curve:

	4a	4b	4c	4d
D10	0.09	0.07	0.13	0.15
D30	0.31	0.32	0.39	0.28
D60	0.82	0.88	0.90	0.72
Cu	9.32	12.57	6.92	4.80
Cz	1.33	1.66	1.30	0.73

Percentages of gravel, sand, silt, and clay-size particle present:

4a	76.2	100		
			17,54	gravel
	2	82,46		
			78,43	sand
	0,063	4,03		
			4,03	silt and clay
	-	0		
4b	76.2	100		
			16,97	gravel
	2	83,03		
			80,61	sand
	0.063	2,42		
			2,42	silt and clay
	-	0		
4c	76.2	100		
			16,13	gravel
	2	83,87		
			81,45	sand
	0.063	2,42		
			2,42	silt and clay
	-	0		
4d	76.2	100		
			14,26	gravel
	2	85,74		
			82,33	sand
	0.063	3,41		
			3,41	silt and clay
	-	0		

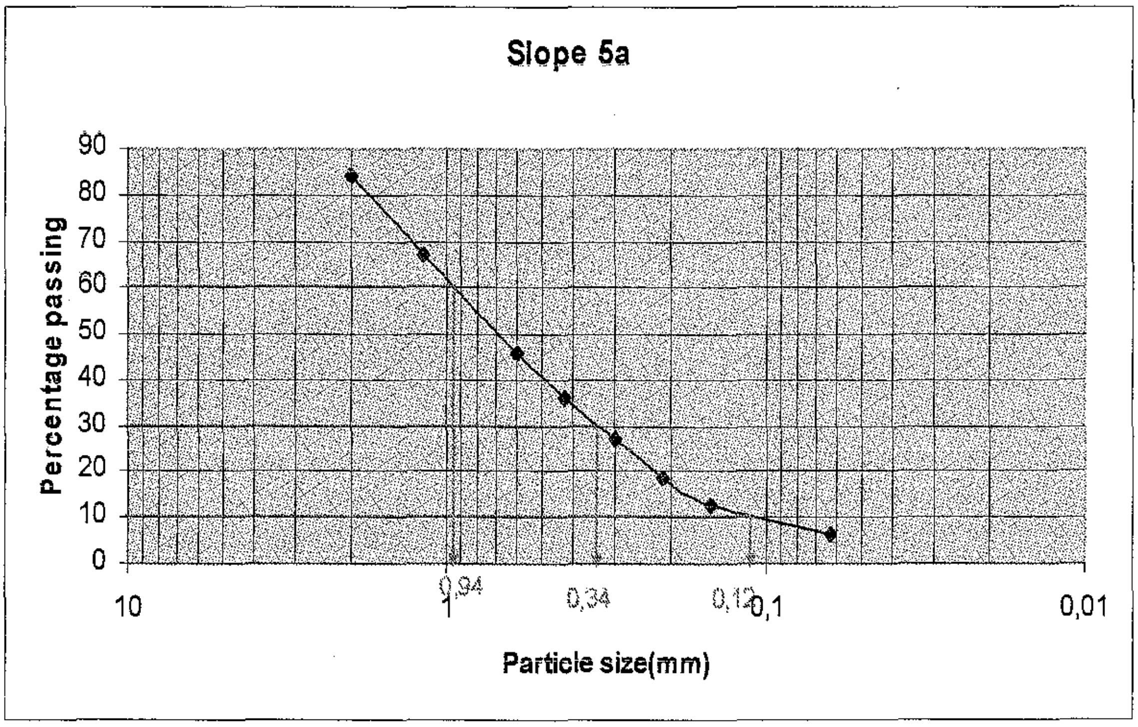
Points	Types of soil using United Classification System
4a	SW with 17.54% of gravel
4b	SW with16.97% of gravel
4c	SW with 16.13% of gravel
4d	SP with 14.26% of gravel
Slope 4	SW with 16.23% of gravel

∵ Slope 4 is mostly well graded sand with 16.23% of gravel

5) Slope 5

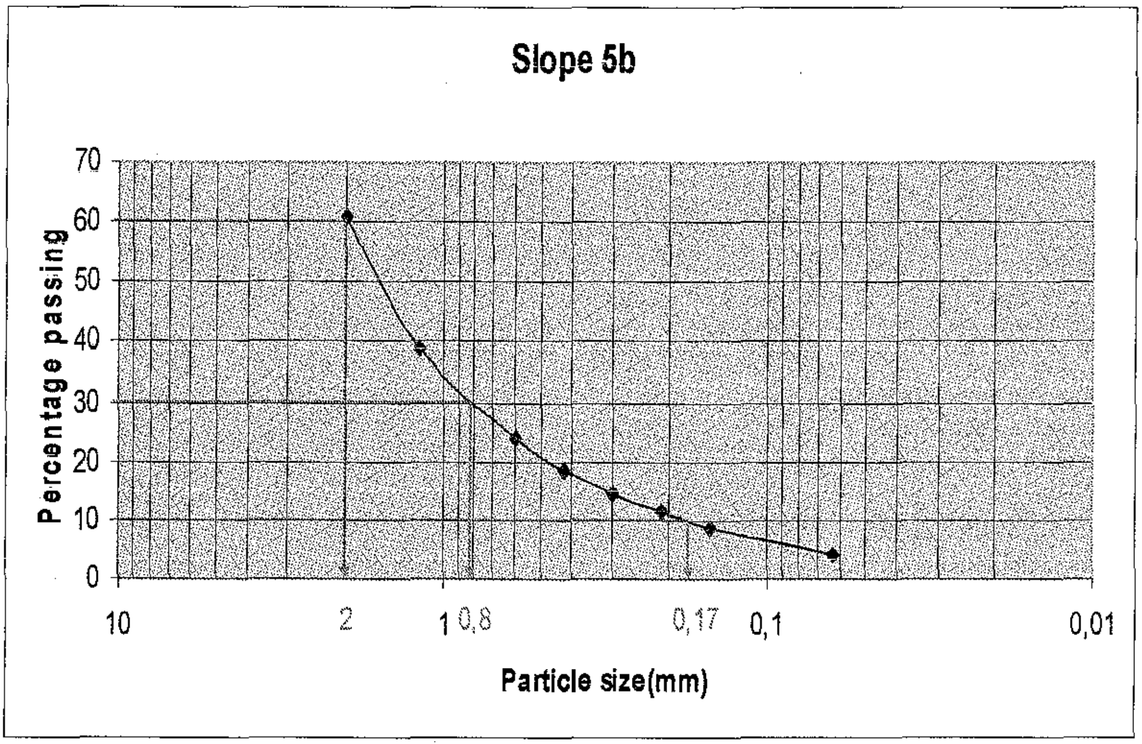
Slope 5a:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.38	0.460	0.080	0.080	83.97
1.18	0.354	0.438	0.084	0.164	67.13
0.6	0.33	0.436	0.106	0.27	45.89
0.425	0.371	0.418	0.047	0.317	36.47
0.3	0.358	0.413	0.055	0.372	25.45
0.212	0.276	0.319	0.043	0.415	16.83
0.15	0.311	0.340	0.029	0.444	11.02
0.063	0.328	0.360	0.032	0.476	4.61
Pan	0.392	0.415	0.023	0.499	0.00
			0.499		



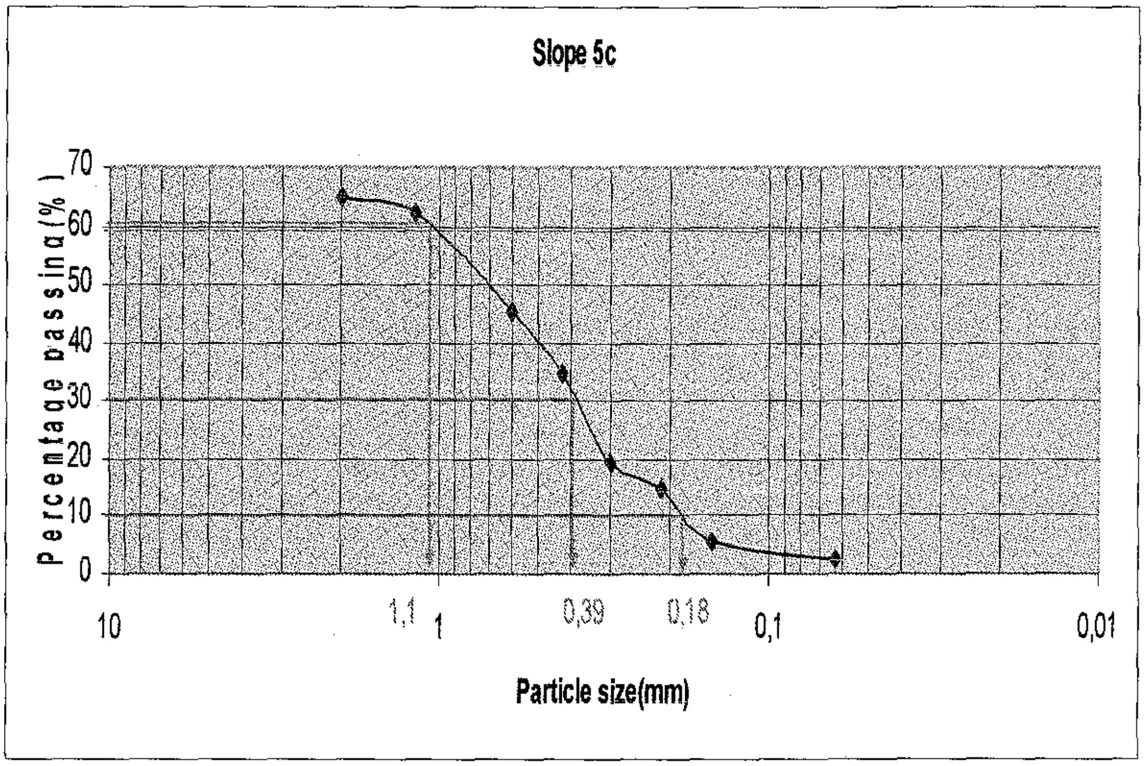
Slope 5b:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.580	0.191	0.191	60.86
1.18	0.426	0.534	0.108	0.299	38.73
0.6	0.33	0.401	0.071	0.370	24.18
0.425	0.296	0.323	0.027	0.397	18.65
0.3	0.286	0.306	0.020	0.417	14.55
0.212	0.340	0.355	0.015	0.432	11.48
0.15	0.276	0.290	0.014	0.446	8.61
0.063	0.327	0.349	0.022	0.468	4.10
Pan	0.246	0.266	0.020	0.488	0.00
			0.488		



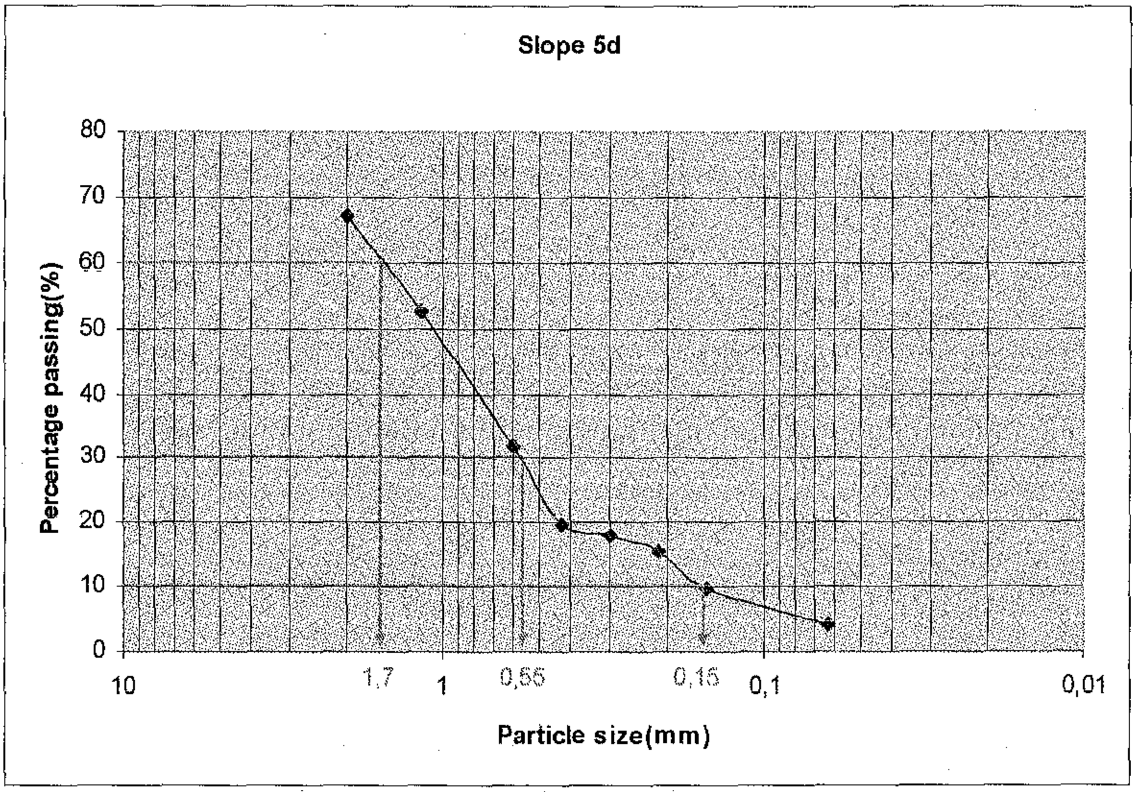
Slope 5c:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.389	0.560	0.171	0.171	64.67
1.18	0.426	0.438	0.012	0.183	62.19
0.6	0.330	0.412	0.082	0.265	45.25
0.425	0.296	0.347	0.051	0.316	34.71
0.3	0.286	0.361	0.075	0.391	19.22
0.212	0.340	0.361	0.021	0.412	14.88
0.15	0.276	0.321	0.045	0.457	5.58
0.063	0.327	0.341	0.014	0.471	2.69
Pan	0.246	0.259	0.013	0.484	0.00
			0.484		



Slope 5d:

Initial dry mass, m1	**500g**				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.551	0.162	0.162	67.07
1.18	0.426	0.497	0.071	0.233	52.64
0.6	0.330	0.432	0.102	0.335	31.91
0.425	0.296	0.356	0.060	0.395	19.72
0.3	0.286	0.295	0.009	0.404	17.89
0.212	0.340	0.352	0.012	0.416	15.45
0.15	0.276	0.304	0.028	0.444	9.76
0.063	0.327	0.354	0.027	0.471	4.27
Pan	0.246	0.267	0.021	0.492	0.00
			0.492		



From curve:

	5a	5b	5c	5d
D10	0.12	0.17	0.18	0.15
D30	0.34	0.80	0.39	0.55
D60	0.94	2.00	1.10	1.70
Cu	7.83	11.76	6.11	11.33
Cz	1.02	1.88	0.77	1.19

Percentages of gravel, sand, silt, and clay-size particle present:

5a	76.2	100		
			16.03	gravel
	2	83.97		
			79.36	sand
	0.063	4.61		
			4.61	silt and clay
	-	0		

5b	76.2	100		
			39.14	gravel
	2	60.86		
			56.76	sand
	0.063	4.10		
			4.10	silt and clay
	-	0		

5c	76.2	100		
			35.33	gravel
	2	64.67		
			61.98	sand
	0.063	2.69		
			2.69	silt and clay
	-	0		

5d	76.2	100		
			32.93	gravel
	2	67.07		
			62.80	sand
	0.063	4.27		
			4.27	silt and clay
	-	0		

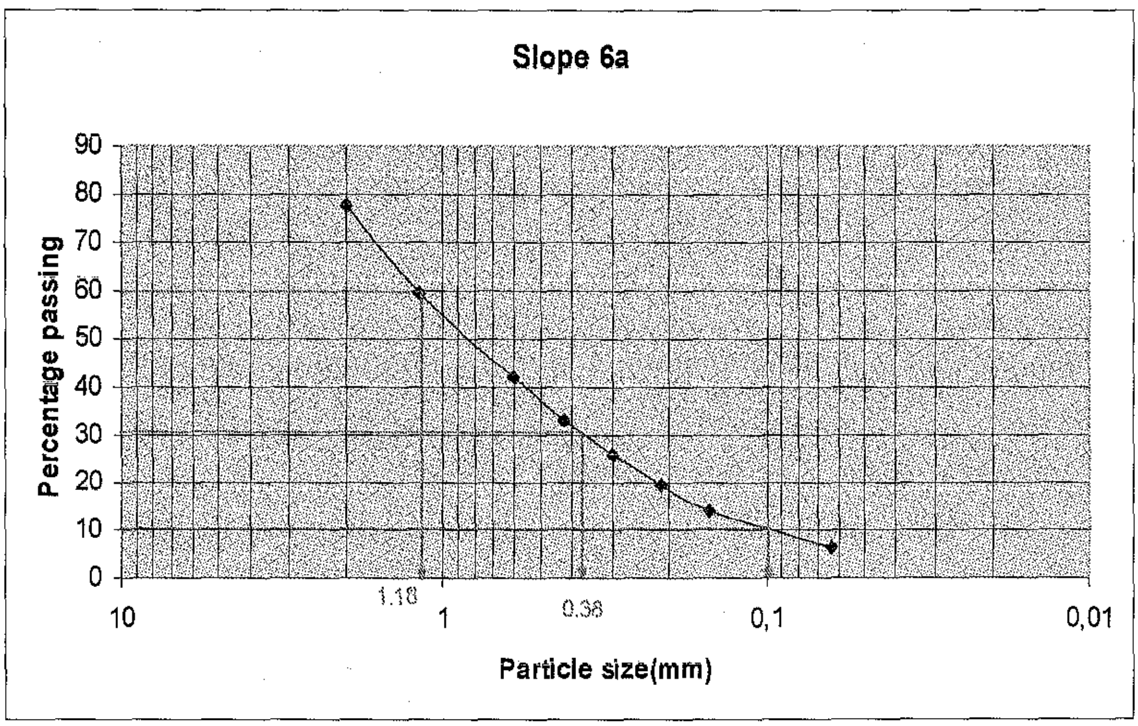
Points	Types of soil using United Classification System
5a	SW with 16.03% of gravel
5b	SW with 39.14% of gravel
5c	SP with 35.55% of gravel
5d	SW with 32.93% of gravel
Slope 5	SW with 16.23% of gravel

∵ Slope 5 is mostly well graded sand with 30.91% of gravel

6) Slope 6

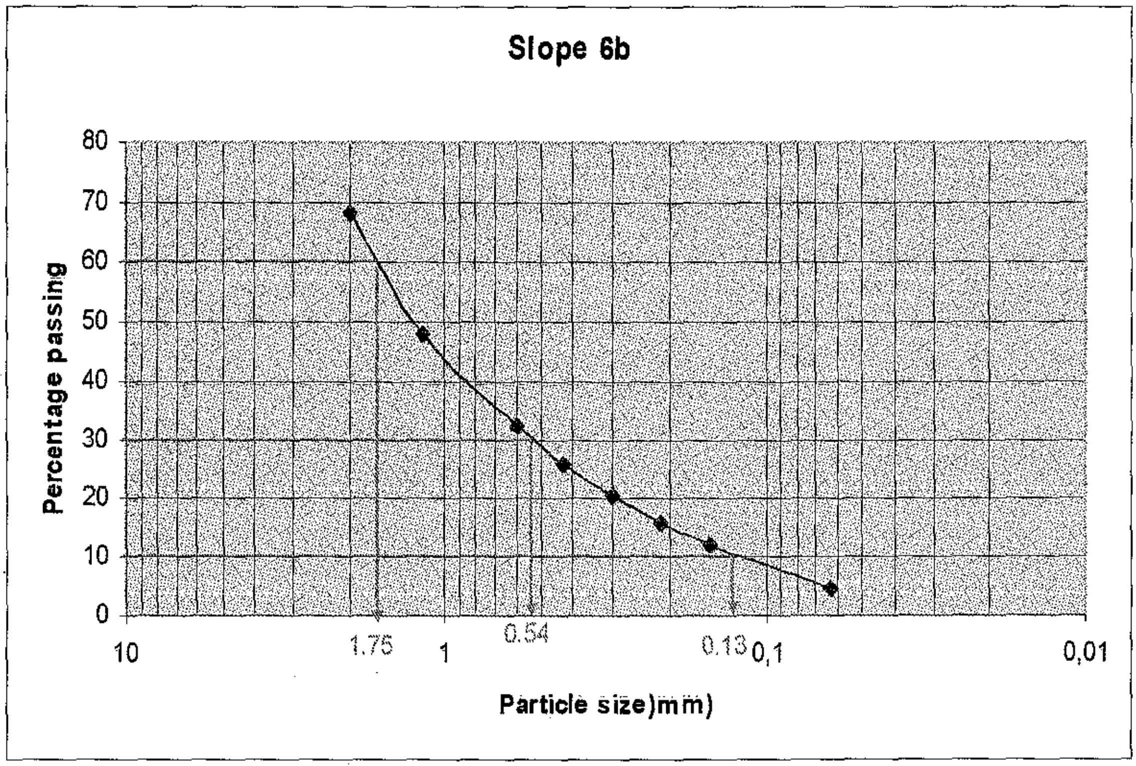
Slope 6a:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.501	0.112	0.112	77.60
1.18	0.426	0.516	0.090	0.202	59.60
0.6	0.330	0.418	0.088	0.290	42.00
0.425	0.296	0.364	0.068	0.358	28.40
0.3	0.286	0.322	0.036	0.394	21.20
0.212	0.340	0.371	0.031	0.425	15.00
0.15	0.276	0.302	0.026	0.451	9.80
0.063	0.327	0.367	0.040	0.491	1.80
Pan	0.246	0.255	0.009	0.500	0.00
			0.5		



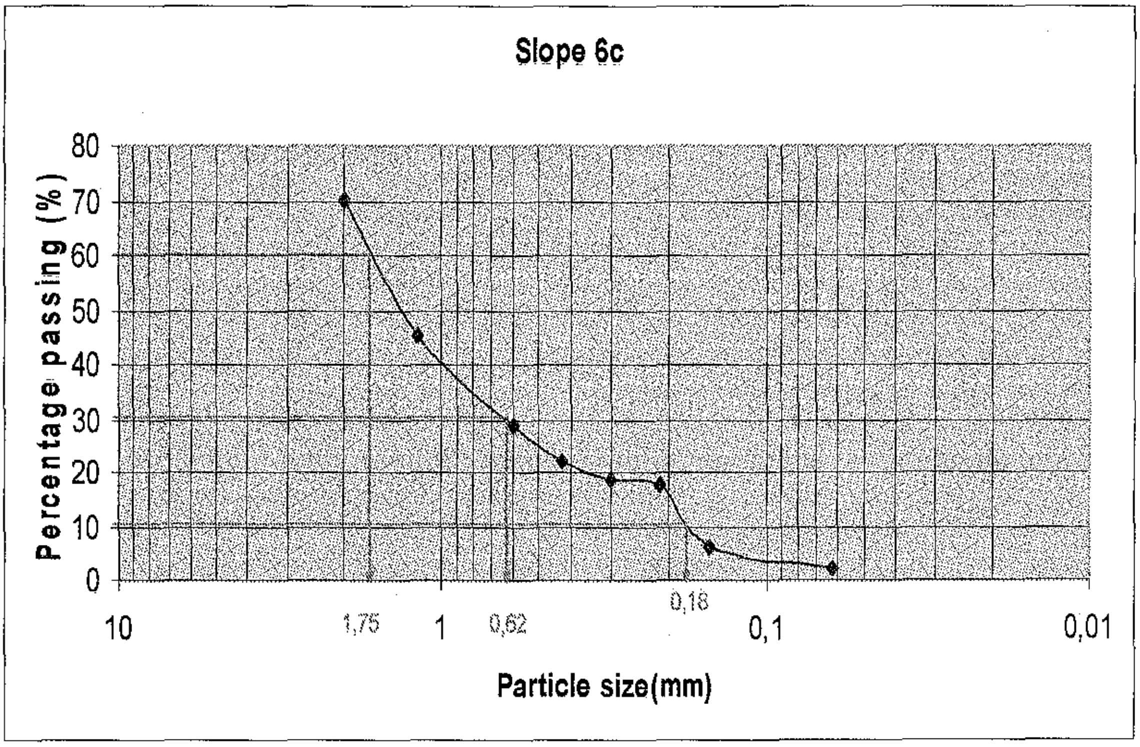
Slope 6b:

Initial dry mass, m1	**500g**				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.548	0.159	0.159	68.20
1.18	0.426	0.528	0.102	0.261	47.80
0.6	0.405	0.481	0.076	0.337	32.60
0.425	0.296	0.329	0.033	0.370	26.00
0.3	0.286	0.314	0.028	0.398	20.40
0.212	0.340	0.363	0.023	0.421	15.80
0.15	0.276	0.295	0.019	0.440	12.00
0.063	0.327	0.364	0.037	0.477	4.60
Pan	0.246	0.269	0.023	0.500	0.00
			0.500		



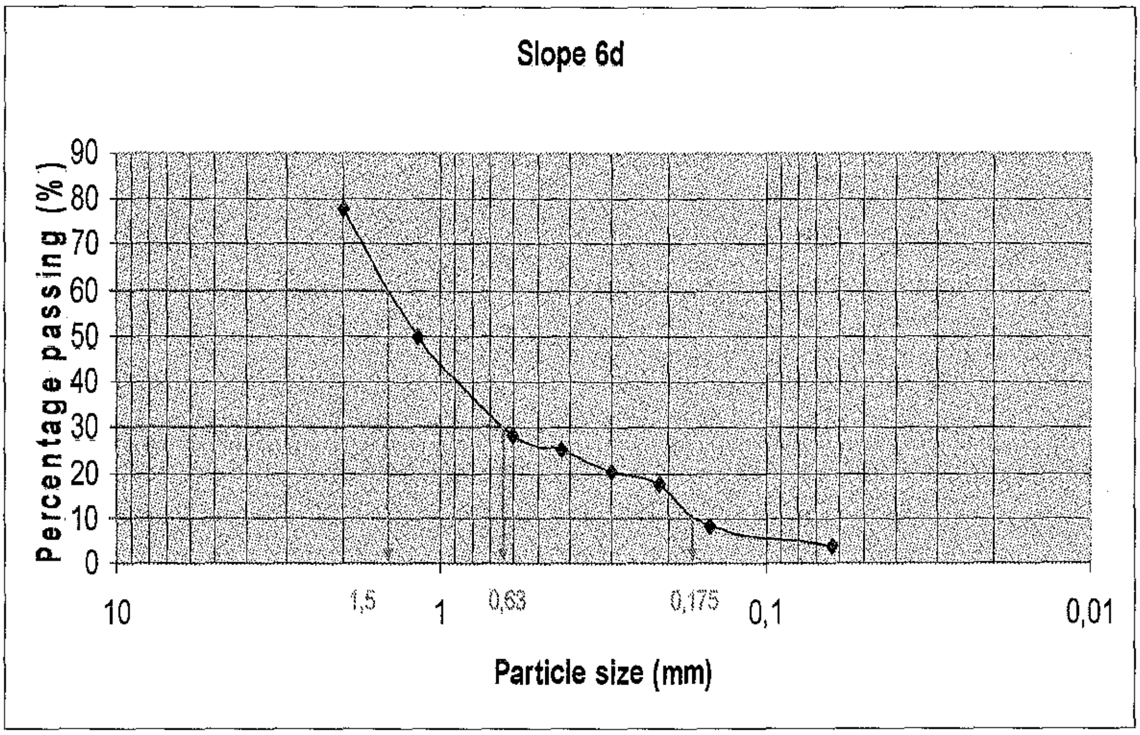
Slope 6c:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.538	0.149	0.149	70.14
1.18	0.426	0.550	0.124	0.273	45.29
0.6	0.330	0.412	0.082	0.355	28.86
0.425	0.296	0.329	0.033	0.388	22.24
0.3	0.286	0.303	0.017	0.405	18.84
0.212	0.340	0.345	0.005	0.410	17.84
0.15	0.276	0.333	0.057	0.467	6.41
0.063	0.327	0.347	0.020	0.487	2.41
Pan	0.246	0.258	0.012	0.499	0.00
			0.499		



Slope 6d:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.389	0.498	0.109	0.109	77.98
1.18	0.426	0.564	0.138	0.247	50.10
0.6	0.330	0.438	0.108	0.355	28.28
0.425	0.296	0.312	0.016	0.371	25.05
0.3	0.286	0.309	0.023	0.394	20.40
0.212	0.340	0.354	0.014	0.408	17.58
0.15	0.276	0.321	0.045	0.453	8.49
0.063	0.327	0.349	0.022	0.475	4.04
Pan	0.246	0.266	0.020	0.495	0.00
			0.495		



From curve:

	6a	6b	6c	6d
D10	0.10	0.13	0.18	0.175
D30	0.38	0.54	0.62	0.63
D60	1.18	1.75	1.75	1.50
Cu	11.80	13.46	9.72	8.57
Cz	1.22	1.28	1.22	1.51

Percentages of gravel, sand, silt, and clay-size particle present:

6a	76.2	100		
			22.4	gravel
	2	77.6		
			75.8	sand
	0.063	1.8		
			1.8	silt and clay
	-	0		

6b	76.2	100		
			31.8	gravel
	2	68.2		
			63.6	sand
	0.063	4.6		
			4.6	silt and clay
	-	0		

6c	76.2	100		
			29.86	gravel
	2	70.14		
			67.73	sand
	0.063	2.41		
			2.41	silt and clay
	-	0		

6d	76.2	100		
			22.02	gravel
	2	77.98		
			73.94	sand
	0.063	4.04		
			4.04	silt and clay
	-	0		

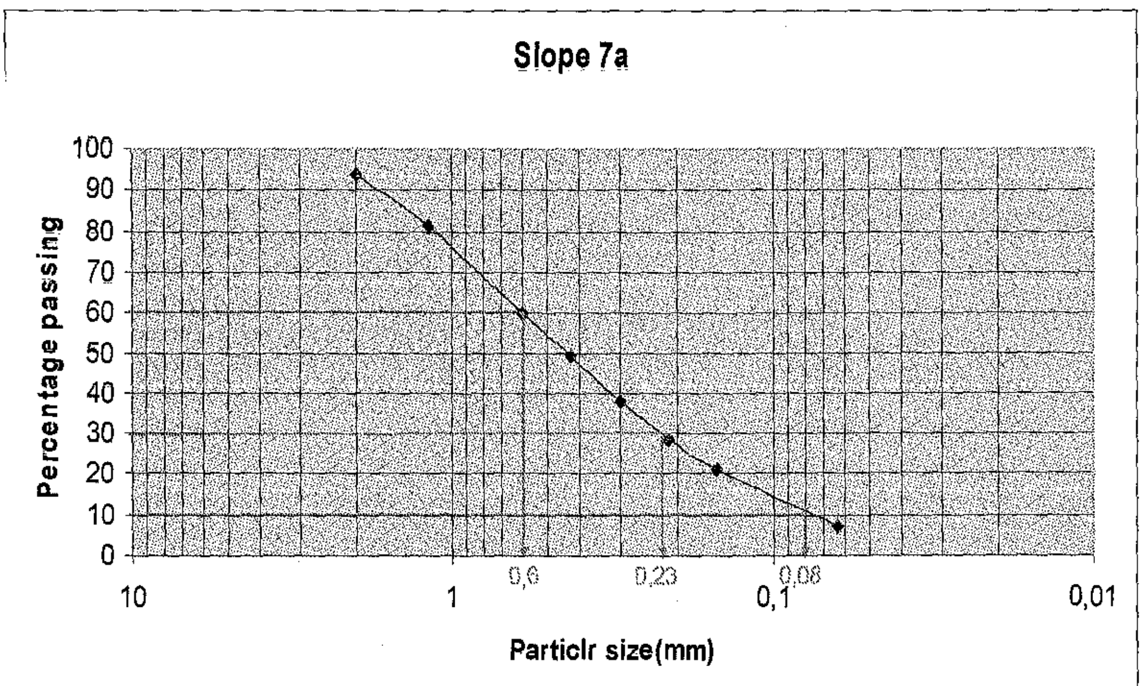
Points	Types of soil using United Classification System
6a	SW with 22.40% of gravel
6b	SW with 31.80% of gravel
6c	SW with 29.86% of gravel
6d	SW with 22.02% of gravel
Slope 6	SW with 26.52% of gravel

∴ Slope 6 is well graded sand with 26.52% of gravel

7) Slope 7

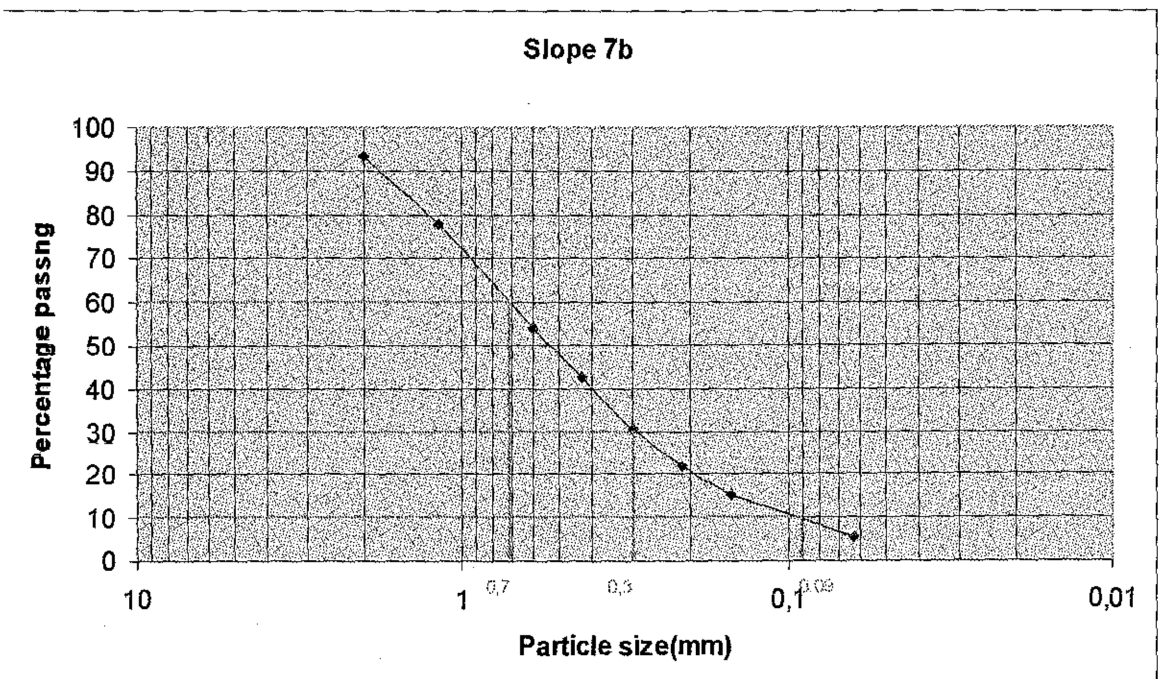
Slope 7a:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.380	0.412	0.032	0.032	93.59
1.18	0.425	0.486	0.061	0.093	81.36
0.6	0.330	0.433	0.103	0.196	60.72
0.425	0.370	0.446	0.076	0.272	45.49
0.3	0.286	0.342	0.056	0.328	34.27
0.212	0.276	0.323	0.047	0.375	24.85
0.15	0.277	0.314	0.037	0.412	17.44
0.063	0.327	0.396	0.069	0.481	3.61
Pan	0.392	0.410	0.018	0.499	0.00
			0.499		



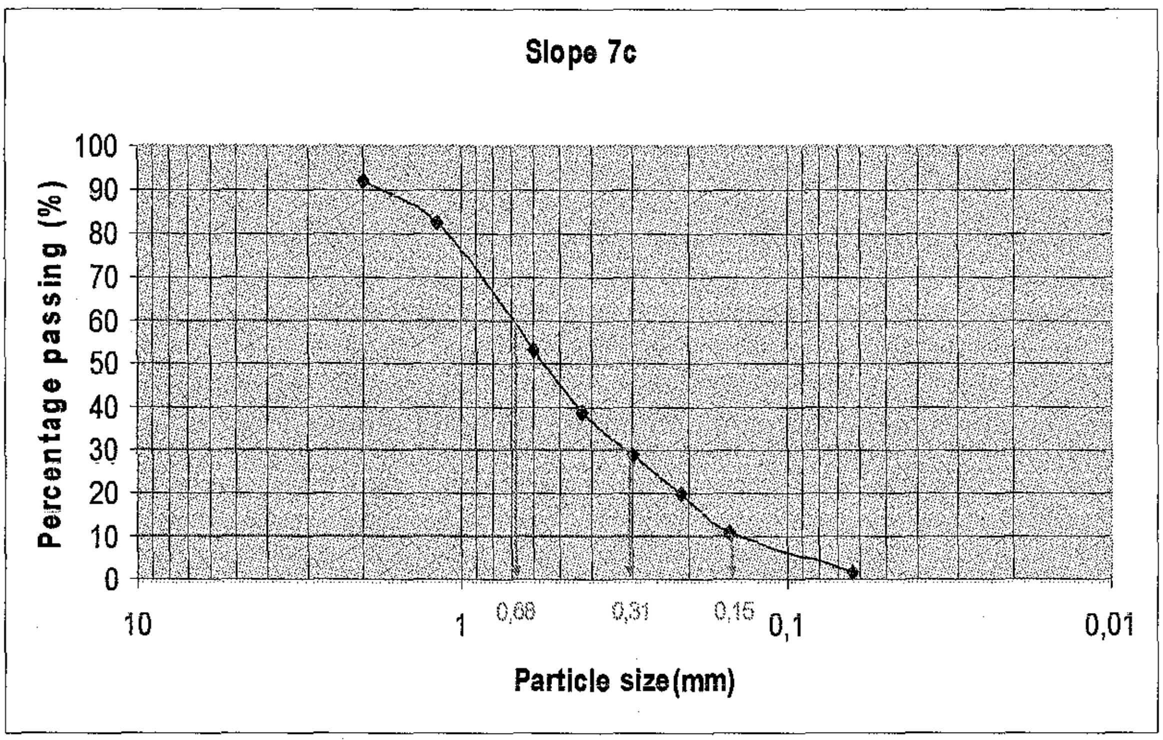
Slope 7b:

Initial dry mass, m1	500g				
		Mass retained, g			
BS test sieve	Weight of sieve	Actual	Corrected (m)	Cumulative retained	Percent finer
2	0.38	0.413	0.033	0.033	93.40
1.18	0.354	0.431	0.077	0.110	78.00
0.6	0.330	0.457	0.127	0.237	52.60
0.425	0.371	0.439	0.068	0.305	39.00
0.3	0.358	0.417	0.059	0.364	27.20
0.212	0.276	0.319	0.043	0.407	18.60
0.15	0.311	0.344	0.033	0.440	12.00
0.063	0.328	0.378	.0.05	0.490	2.00
Pan	0.392	0.402	0.01	0.500	0.00
			0.500		



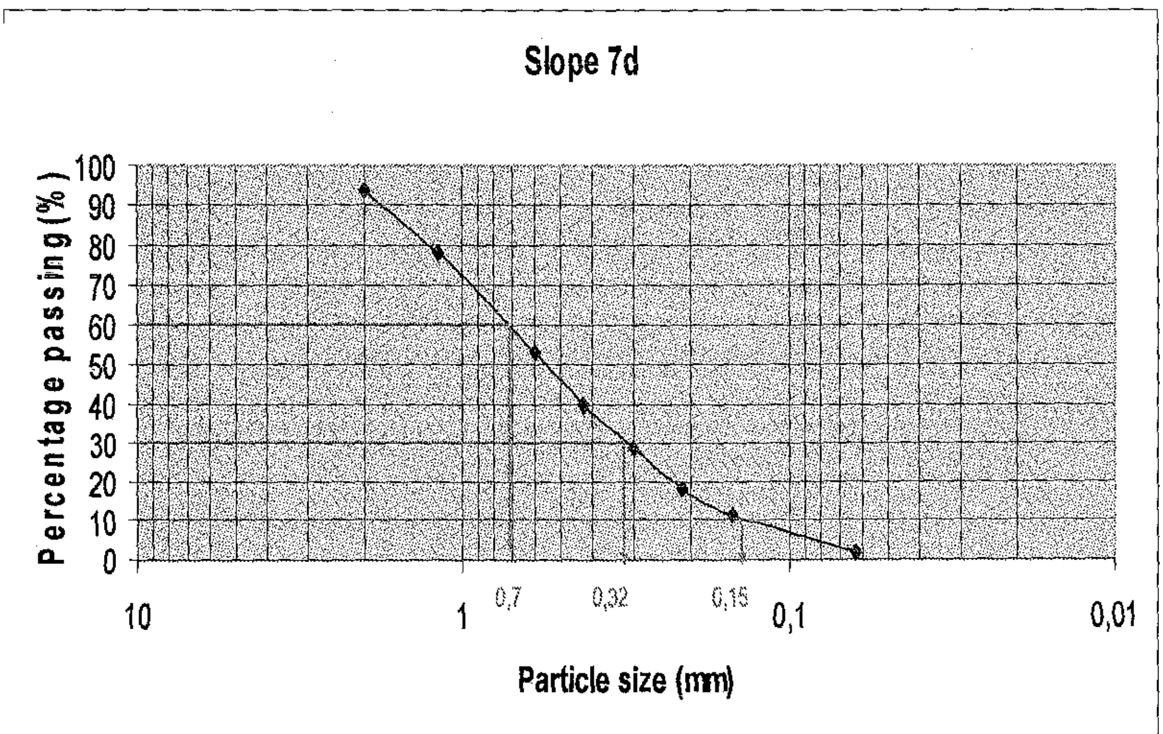
Slope 7c:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.380	0.419	0.039	0.039	92.18
1.18	0.354	0.401	0.047	0.086	82.77
0.6	0.330	0.476	0.146	0.232	53.51
0.425	0.371	0.442	0.071	0.303	39.28
0.3	0.358	0.410	0.052	0.355	28.86
0.212	0.276	0.320	0.044	0.399	20.04
0.15	0.311	0.355	0.044	0.443	11.22
0.063	0.328	0.377	0.049	0.492	1.40
Pan	0.392	0.399	0.007	0.499	0.00
			0.499		



Slope 7d:

Initial dry mass, m1	500g				
BS test sieve	**Weight of sieve**	**Mass retained, g**		**Cumulative retained**	**Percent finer**
		Actual	**Corrected (m)**		
2	0.380	0.410	0.030	0.030	93.75
1.18	0.354	0.429	0.075	0.105	78.13
0.6	0.330	0.450	0.120	0.225	53.13
0.425	0.371	0.433	0.062	0.287	40.21
0.3	0.358	0.412	0.054	0.341	28.96
0.212	0.276	0.329	0.053	0.394	17.92
0.15	0.311	0.343	0.032	0.426	11.25
0.063	0.328	0.374	0.046	0.472	1.67
Pan	0.392	0.400	0.008	0.480	0.00
			0.480		



From curve:

	7a	7b	7c	7d
D10	0.08	0.09	0.15	0.15
D30	0.23	0.30	0.31	0.32
D60	0.60	0.70	0.68	0.70
Cu	7.50	7.78	4.53	4.67
Cz	1.10	1.43	0.94	0.98

Percentages of gravel, sand, silt, and clay-size particle present:

	76.2	100		
			6.41	gravel
	2	93.59		
7a			89.98	sand
	0.063	3.61		
			3.61	silt and clay
	-	0		

	76.2	100		
			6.60	gravel
	2	93.40		
7b			91.40	sand
	0.063	2.00		
			2.00	silt and clay
	-	0		

	76.2	100		
			7.82	gravel
	2	92.18		
7c			90.78	sand
	0.063	1.40		
			1.40	silt and clay
	-	0		

	76.2	100		
			6.25	gravel
	2	93.75		
7d			92.08	sand
	0.063	1.67		
			1.67	silt and clay
	-	0		

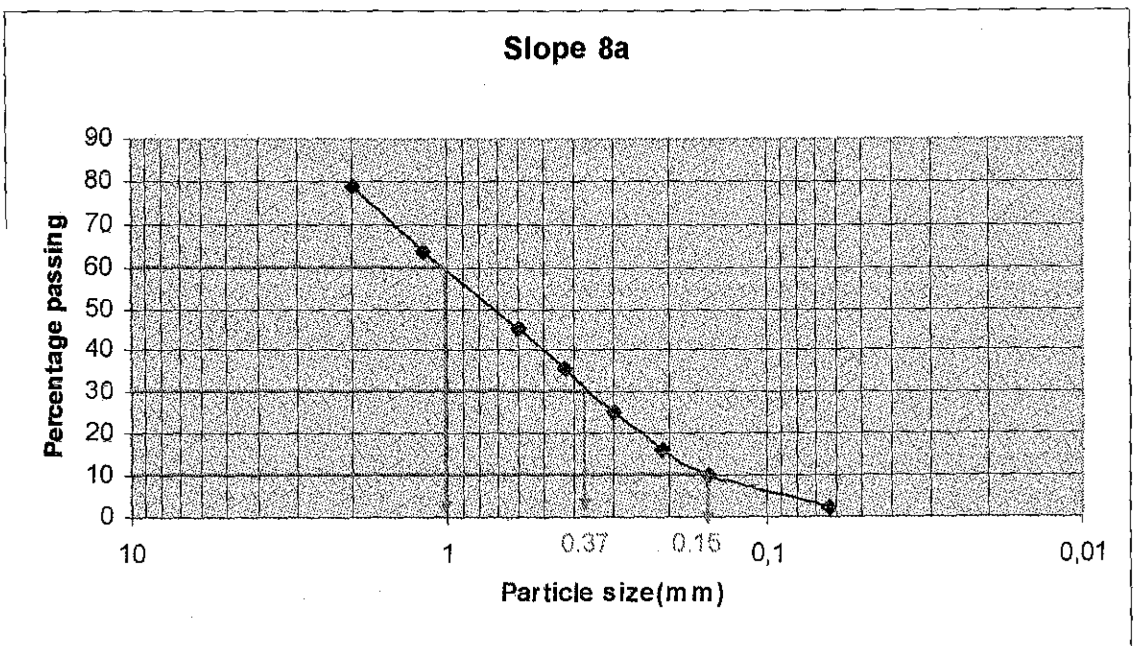
Points	Types of soil using United Classification System
7a	SW with 6.41% of gravel
7b	SW with 6.60% of gravel
7c	SP with 7.82% of gravel
7d	SP with 6.25% of gravel
Slope 7	SP with 6.77% of gravel

∴ Slope 7 is considered poorly graded sand with 6.77% of gravel

8) Slope 8

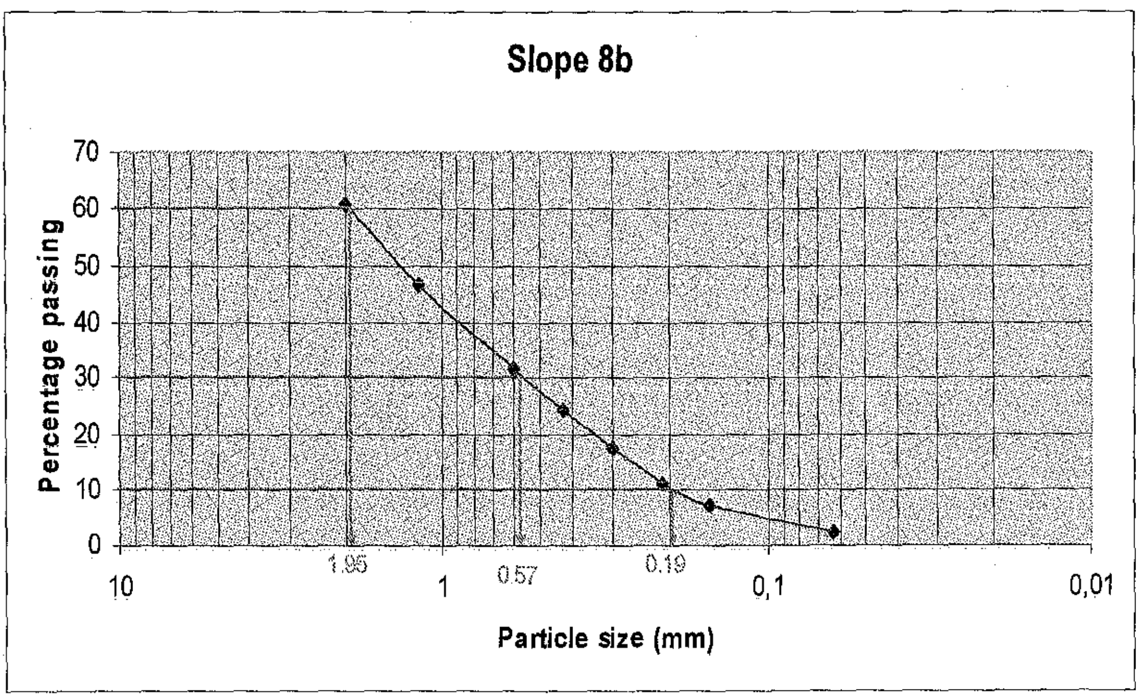
Slope 8a:

Initial dry mass, m1	500g				
		Mass retained, g			
BS test sieve	Weight of sieve	Actual	Corrected (m)	Cumulative retained	Percent finer
2	0.381	0.488	0.107	0.107	78.56
1.18	0.435	0.508	0.073	0.180	63.93
0.6	0.406	0.498	0.092	0.272	45.49
0.425	0.371	0.419	0.048	0.320	35.87
0.3	0.355	0.408	0.053	0.373	25.25
0.212	0.276	0.320	0.044	0.417	16.43
0.15	0.269	0.300	0.031	0.448	10.22
0.063	0.327	0.367	0.040	0.488	2.20
Pan	0.392	0.403	0.011	0.499	0.00
			0.499		



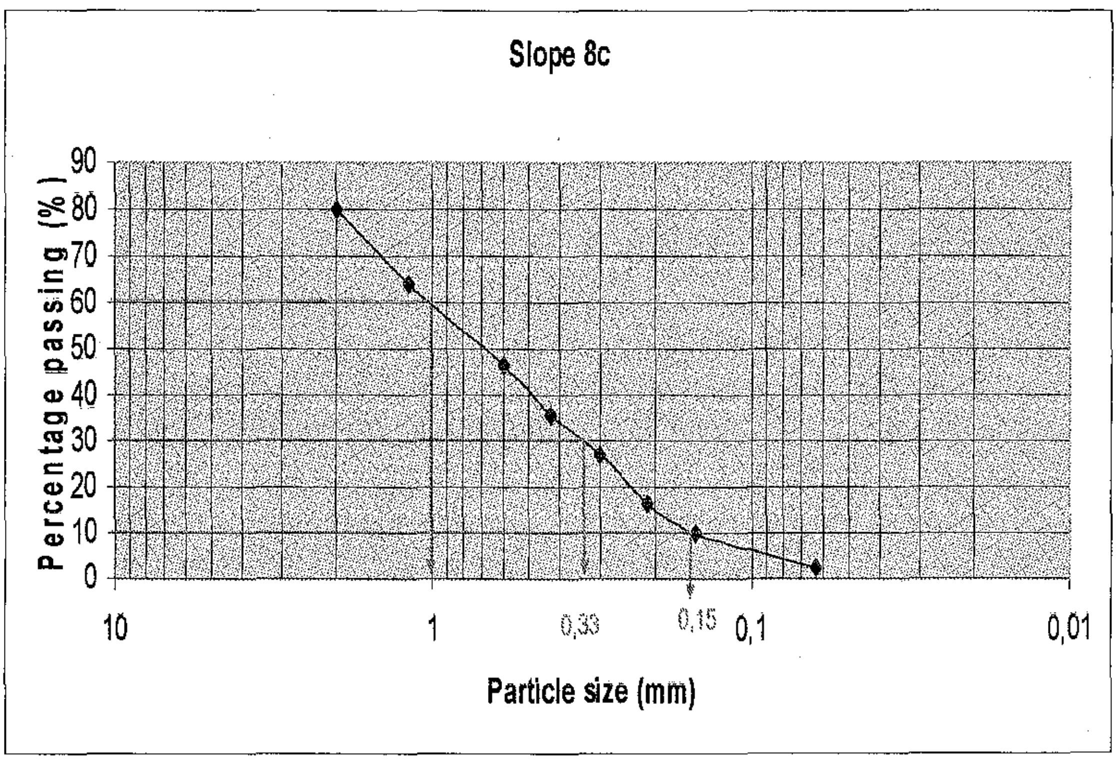
Slope 8b:

Initial dry mass, m1	500g				
BS test sieve	Weight of sieve	Mass retained, g		Cumulative retained	Percent finer
		Actual	Corrected (m)		
2	0.38	0.572	0.192	0.192	60.82
1.18	0.425	0.495	0.07	0.262	46.53
0.6	0.330	0.403	0.073	0.335	31.63
0.425	0.370	0.405	0.035	0.370	24.49
0.3	0.286	0.320	0.034	0.404	17.55
0.212	0.276	0.306	0.030	0.434	11.43
0.15	0.277	0.298	0.021	0.455	7.14
0.063	0.327	0.350	0.023	0.478	2.45
Pan	0.392	0.404	0.012	0.490	0.00
			0.49		



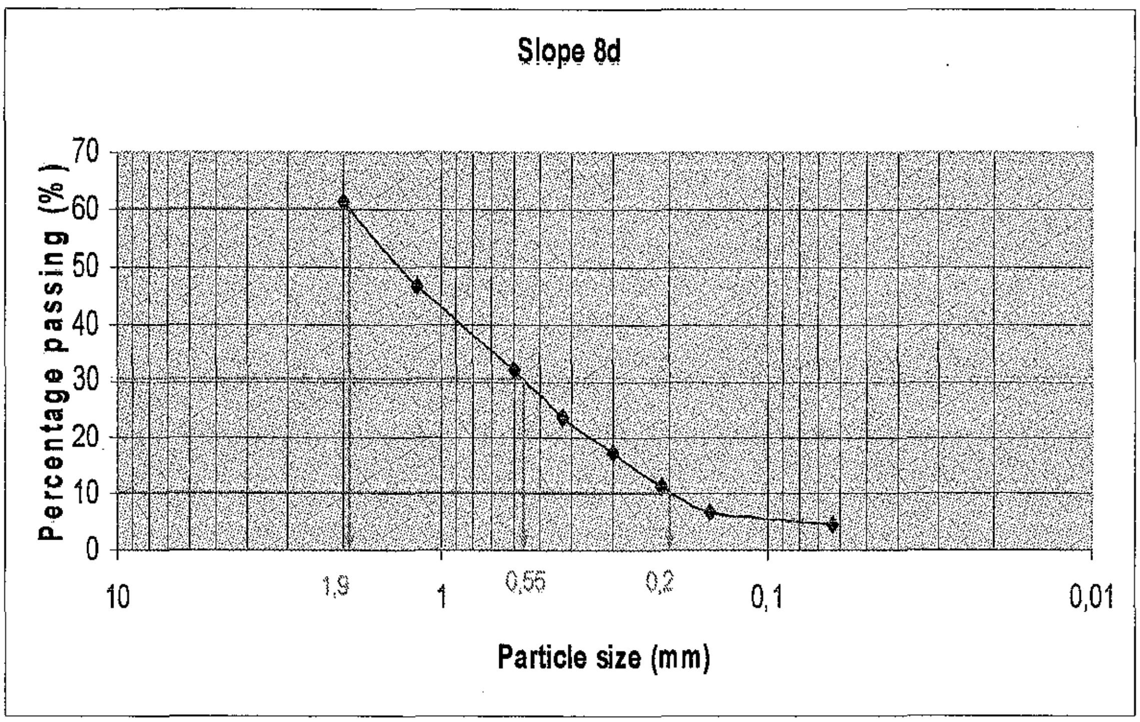
Slope 8c:

Initial dry mass, m1	500g				
		Mass retained, g			
BS test sieve	Weight of sieve	Actual	Corrected (m)	Cumulative retained	Percent finer
2	0.381	0.482	0.101	0101	79.76
1.18	0.435	0.514	0.079	0.180	63.93
0.6	0.406	0.492	0.086	0.266	46.69
0.425	0.371	0.425	0.054	0.320	35.87
0.3	0.355	0.400	0.045	0.365	26.85
0.212	0.276	0.328	0.052	0.417	16.43
0.15	0.269	0.302	0.033	0.450	9.82
0.063	0.327	0.365	0.038	0.488	2.20
Pan	0.392	0.403	0.011	0.499	0.00
			0.499		



Slope 8d:

Initial dry mass, m1	500g				
		Mass retained, g			
BS test sieve	Weight of sieve	Actual	Corrected (m)	Cumulative retained	Percent finer
2	0.380	0.574	0.194	0.194	61.20
1.18	0.425	0.497	0.072	0.266	46.80
0.6	0.330	0.404	0.074	0.340	32.00
0.425	0.370	0.410	0.04	0.380	24.00
0.3	0.286	0.320	0.034	0.414	17.20
0.212	0.276	0.304	0.028	0.442	11.60
0.15	0.277	0.300	0.023	0.465	7.00
0.063	0.327	0.340	0.013	0.478	4.40
Pan	0.392	0.414	0.022	0.500	0.00
			0.500		



From curve:

	8a	8b	8c	8d
D10	0.15	0.19	0.15	0.20
D30	0.37	0.57	0.33	0.55
D60	1.00	1.95	1.00	1.90
Cu	6.67	10.26	6.67	9.50
Cz	0.91	0.88	0.73	0.80

Percentages of gravel, sand, silt, and clay-size particle present:

8a	76.2	100
	2	78.560
	0.063	2.20
	-	0

21.44	gravel
76.36	sand
2.20	silt and clay

8b	76.2	100
	2	60.82
	0.063	2.45
	-	0

39.18	gravel
58.37	sand
2.45	silt and clay

8c	76.2	100
	2	79.76
	0.063	2.20
	-	0

20.24	gravel
77.56	sand
2.20	silt and clay

8d	76.2	100
	2	61.20
	0.063	4.40
	-	0

38.80	gravel
56.80	sand
4.40	silt and clay

Points	Types of soil using United Classification System
8a	SP with 21.44% of gravel
8b	SP with 39.18% of gravel
8c	SP with 20.24% of gravel
8d	SP with 38.80% of gravel
Slope 8	SP with 29.92% of gravel

∴ Slope 8 is poorly graded sand with 29.92% of gravel

Summary of the results:

Slope ID	Types of soil
Slope 1	SW with 22.78% of gravel
Slope 2	SW with 29.65% of gravel
Slope 3	SP with 25.29% of gravel
Slope 4	SW with 16.23% of gravel
Slope 5	SW with 16.23% of gravel
Slope 6	SW with 26.52% of gravel
Slope 7	SP with 6.77% of gravel
Slope 8	SP with 29.92% of gravel

Table 2.1: K Factor Data

Soil Type	K factor
Loamy fine sand	0.20
Very fine sand	0.36
Loamy very fine sand	0.38
Silty loam	0.42
Sandy clay loam	0.25
Clay loam	0.25
Silty clay	0.23

(USEPA, Agriculture Research Service, U.S. Department of Agriculture, 1975)

K factor value

Slope ID	Types of soil in UCS	Types of soil for K factor	K factor
Slope 1	SW with 22.78% of gravel	Loamy fine sand	0.20
Slope 2	SW with 29.65% of gravel	Loamy fine sand	0.20
Slope 3	SP with 25.29% of gravel	Loamy fine sand	0.20
Slope 4	SW with 16.23% of gravel	Loamy fine sand	0.20
Slope 5	SW with 16.23% of gravel	Loamy fine sand	0.20
Slope 6	SW with 26.52% of gravel	Loamy fine sand	0.20
Slope 7	SP with 6.77% of gravel	Loamy fine sand	0.20
Slope 8	SP with 29.92% of gravel	Loamy fine sand	0.20

APPENDIX D

LS factor

Table 1: Data of slope

NO	SLOPE ID	Start (KM)	End (KM)	Angle (deg)	Height (m)
1	Slope 1	255.10	255.55	40	30
2	Slope 2	256.05	256.60	40	50
3	Slope 3	259.88	260.12	40	90
4	Slope 4	260.55	261.00	40	30
5	Slope 5	261.85	262.05	40	50
6	Slope 6	265.97	266.20	40	50
7	Slope 7	261.90	261.80	40	65
8	Slope 8	262.58	262.25	40	25

LS can be calculated by this equation:

$LS = (L/22.1)^{0.5} (0.065 + 0.045\, S + 0.0065\, S^2)$ ………(Wischemeir and Smith, 1978)

where,

L = slope length in m

S = slope gradient in percent

Calculation of L:

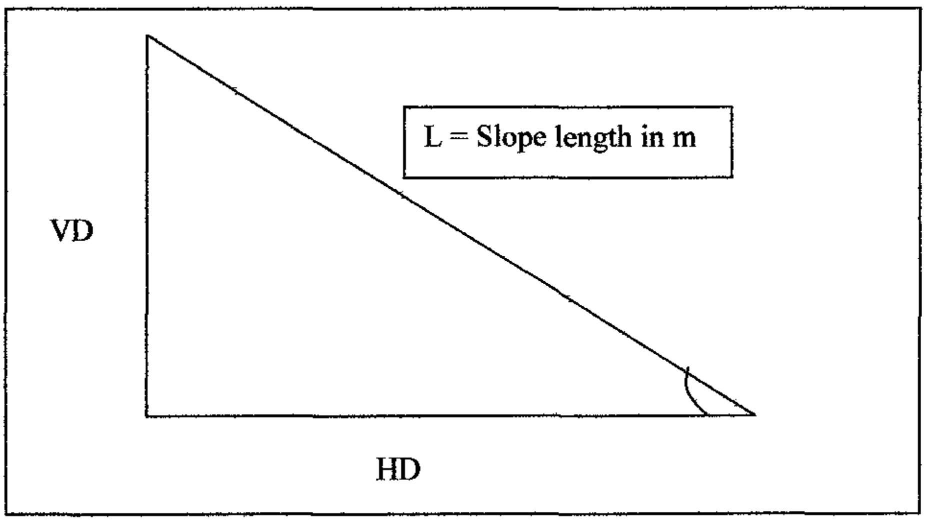


Figure 1: Slope diagram to calculate slope length , L

VD = given

$L \quad = VD / \sin \theta$

Where,

L = Vertical distance

θ = Degree of slope

L slope 1 = 30 / sin 40°

= **46.67 m**

L slope 2 = 50 / sin 40°

= **77.79 m**

L slope 3 = 90 / sin 40°

= **140.02 m**

L slope 4 = 30 / sin 40°

= **46.67 m**

L slope 5 = 50 / sin 40°

= **77.79 m**

L slope 6 = 50 / sin 40°

= **77.79 m**

L slope 7 = 65 / sin 40°

= **101.12 m**

L slope 8 = 25 / sin 40°

= **38.89 m**

Table 2: L value

Slope ID	VD (m)	Angle,θ (deg)	L (m)
Slope 1	30	40	46.67
Slope 2	50	40	77.79
Slope 3	90	40	140.02
Slope 4	30	40	46.67
Slope 5	50	40	77.79
Slope 6	50	40	77.79
Slope 7	65	40	101.12
Slope 8	25	40	38.89

<u>Calculation of S:</u>

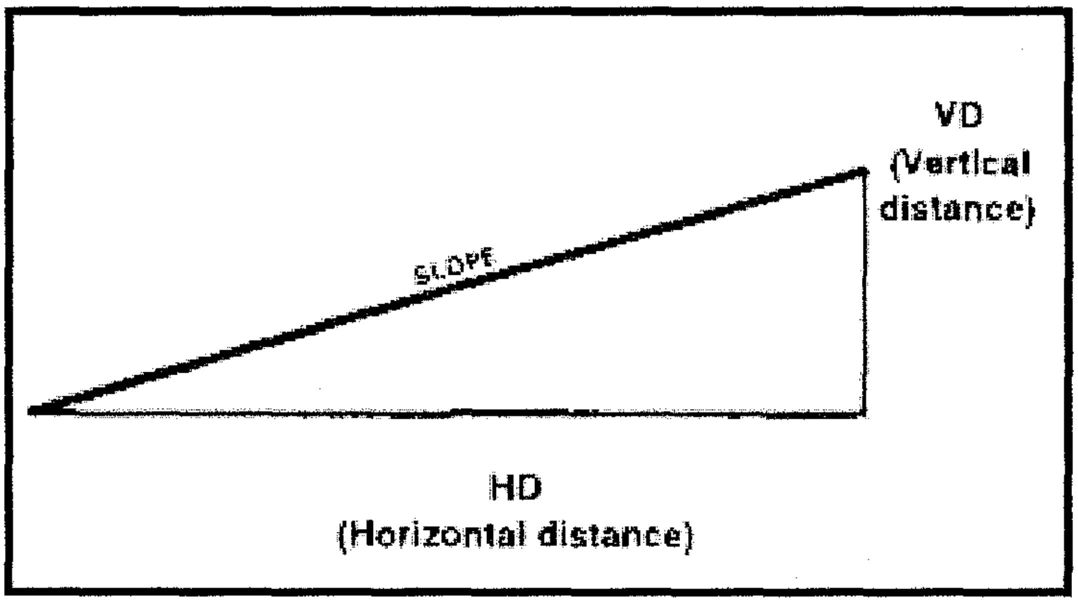


Figure 2: Slope diagram to calculate slope steepness, S

Percentage of slope: (VD x 100)/ HD

where,

VD = Vertical distance

HD = Horizontal distance

HD slope 1 = 30 / tan 40°

= **35.75 m**

HD slope 2 = 50 / tan 40°

= **59.59 m**

HD slope 3 = 90 / tan 40°

= **107.26 m**

HD slope 4 = 30 / tan 40°

= **35.75 m**

HD slope 5 = 50 / tan 40°

= **59.59 m**

HD slope 6 = 50 / tan 40°

= **59.59 m**

HD slope 7 = 65 / tan 40°

= **77.46 m**

HD slope 8 = 25 / tan 40°

= **29.79 m**

Table 3: HD value

Slope ID	VD (m)	Angle,θ (deg)	HD (m)
Slope 1	30	40	35.75
Slope 2	50	40	59.59
Slope 3	90	40	107.26
Slope 4	30	40	35.75
Slope 5	50	40	59.59
Slope 6	50	40	59.59
Slope 7	65	40	77.46
Slope 8	25	40	29.79

Percentage of slope, S: (VD x 100) / HD

The vertical distances were multiplied by 100. Then, the totals were divided by the horizontal distance. The result is in percentage of slope.

S slope 1 = (30 x 100) / 35.75
= 83.9 %

S slope 2 = (50 x 100) / 59.59
= 83.93 %

S slope 3 = (90 x 100) / 107.26
= 83.9 %

S slope 4 = (30 x 100) / 35.75
= 83.91 %

S slope 5 = (50 x 100) / 59.59
= 83.9 %

S slope 6 = (50 x 100) / 59.59

= 83.9 %

S slope 7 = (65 x 100) / 77.46

= 83.9 %

S slope 8 = (25 x 100) / 29.79

= 83.9 %

Table 4: S value

Slope ID	VD (m)	Angle,θ (deg)	HD (m)	S (%)
Slope 1	30	40	35.75	83.9
Slope 2	50	40	59.59	83.9
Slope 3	90	40	107.26	83.9
Slope 4	30	40	35.75	83.9
Slope 5	50	40	59.59	83.9
Slope 6	50	40	59.59	83.9
Slope 7	65	40	77.46	83.9
Slope 8	25	40	29.79	83.9

<u>Calculation of LS:</u>

$LS = (L/22.1)^{0.5} (0.065 + 0.045\ S + 0.0065\ S^2)$

LS slope 1 = $(46.67 / 22.1)^{0.5} (0.065 + 0.045\ (83.9) + 0.0065\ (83.9^2))$

= 72.07

LS slope 2 = $(77.79 / 22.1)^{0.5} (0.065 + 0.045\ (83.9) + 0.0065\ (83.9^2))$

= 93.05

LS slope 3 = $(140.02 / 22.1)^{0.5} (0.065 + 0.045\ (83.9) + 0.0065\ (83.9^2))$

= 124.84

$$LS\ slope\ 4 = (46.67 / 22.1)^{0.5} (0.065 + 0.045 (83.9) + 0.0065 (83.9^2))$$
$$= 72.07$$

$$LS\ slope\ 5 = (77.79 / 22.1)^{0.5} (0.065 + 0.045 (83.9) + 0.0065 (83.9^2))$$
$$= 93.05$$

$$LS\ slope\ 6 = (77.79 / 22.1)^{0.5} (0.065 + 0.045 (83.9) + 0.0065 (83.9^2))$$
$$= 93.05$$

$$LS\ slope\ 7 = (101.12 / 22.1)^{0.5} (0.065 + 0.045 (83.9) + 0.0065 (83.9^2))$$
$$= 106.09$$

$$LS\ slope\ 8 = (38.89 / 22.1)^{0.5} (0.065 + 0.045 (83.9) + 0.0065 (83.9^2))$$
$$= 65.79$$

Table 5: LS factor

Slope ID	L (m)	S (%)	LS factor
Slope 1	46.67	83.9	72.07
Slope 2	77.79	83.9	93.05
Slope 3	140.02	83.9	124.84
Slope 4	46.67	83.9	72.07
Slope 5	77.79	83.9	93.05
Slope 6	77.79	83.9	93.05
Slope 7	101.12	83.9	106.09
Slope 8	38.89	83.9	65.79

APPENDIX E

Types of Vegetation

Figure 1: Forested

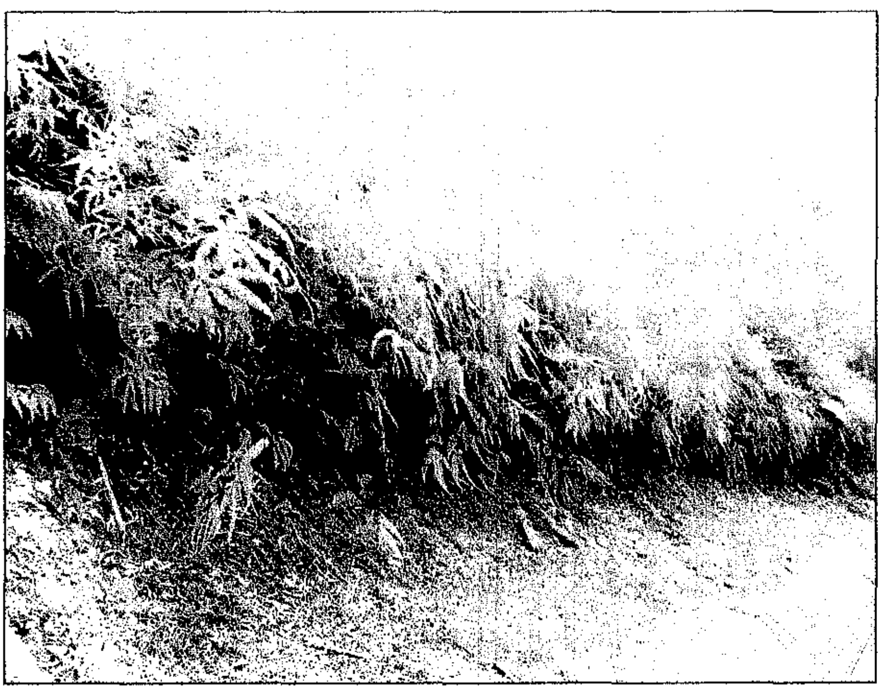


Figure 2: Fern

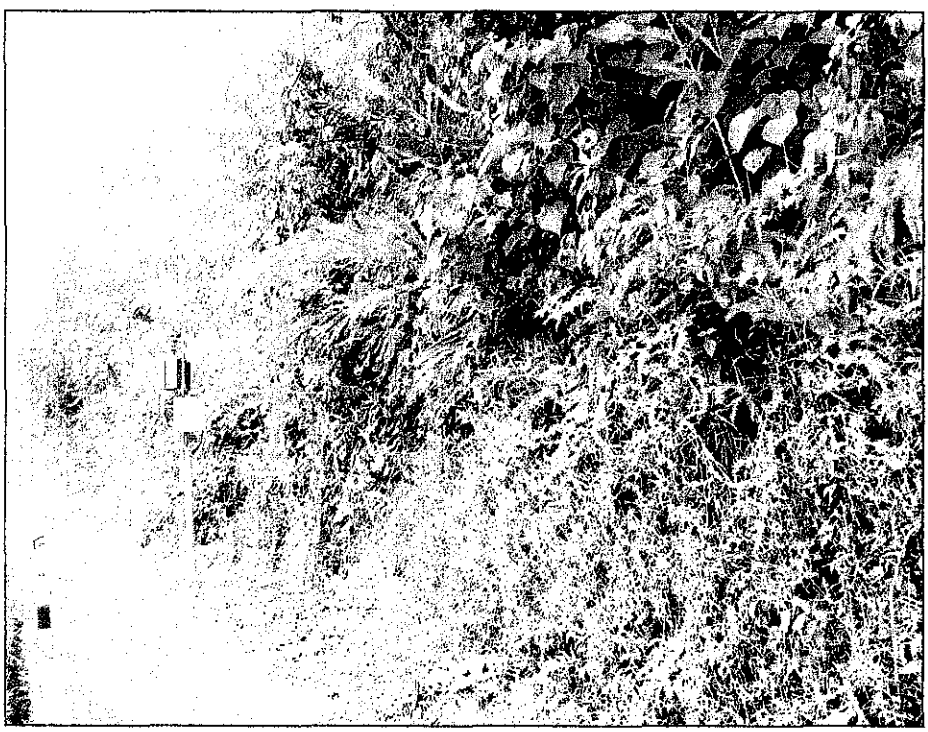


Figure 3: Bushes