13.1.5 Plant Check List

This list contains both indigenous and exotic tree species found within the study area. The exotic species are marked with an asterisk (*). The arrangement is by family alphabetical order, as are the genera and species within each family. The growth form of each species is indicated by an abbreviation at the end of the scientific name: T = Tree, S = Shrub, C = Climber/liane, H = herb. Dicots are listed first followed by monocots.

a. Dicots

ACANTHACEAE

Ruellia patula S. Moore; H

AIZOACEAE

Corbichonia decumbens

AMARANTHACEAE

Achyranthes aspera L.; H

Alternanthera pungens Kunth; H

* *Amaranthus hybridus* L.; H

Psilotrichum boivinianum (Baill.) Cavaco; H

ANACARDIACEAE

* *Anacardium occidentale* L.; T

Lannea schweinfurthii (Engl.) Engl.; T

* *Mangifera indica* L.; T

Sclerocarya birrea (Engl.) Engl.; T

ANNONACEAE

Annona senegalensis Pers.; T

Uvaria acuminata Oliv.; C

Uvaria kirkii Oliv.; S/C

ASCLPIADACEAE

Calotropis procera L.; S

BIGNONIACEAE

Markhamia zanzibarica (Benth.) K.Schum.; S/T

BOMBACEAE

Adansonia digitata L.; T

* *Ceiba pentandra* (L.) Gaertner; T

BORAGINACEAE

Ehretia amoena Klotsch; S

Heliotropium stendneri Vatke; H

BURCERACEAE

Commiphora africana (A. Rich.) Eng.; S/T

CAPPARACEAE

Capparis fascicularis DC.; C

Maerua angolensis

CACTACEAE

Opuntia vulgaris

CAESALPINIACEA

Cassia abbreviatra Oliv.; T

* *Delonix regia* (Hook.) Raf.; T

* *Senna siamea* (Lam.) Irwin & Barneby; T

* *Tamarindus indica* L

CARICACEAE

* *Carica papaya* L.; S

CASUARINACEAE

* *Casuarina equisetifolia* L.; T (produces best firewood in the world)

COMBRETACEAE

Combretum pentagonum Laws., C

COMPOSITAE

Emilia coccinea (Sims) G. Don; S

Lactuca cornuta H

Pluchea dioscoridis DC.; H/S

Vernonia cinerea (L.) Less.; H

EBENACEAE

Euphorbia cuneata Vahl ssp. *cuneata;* S

Euclea natalensis A.DC.; S

EUPHORBIACEAE

Euphorbia hirta L.; H

Euphorbia hyssopifolia L.; H

Euphorbia indica Lam.; H

Flueggea virosa (Wildd.) Voigt; S

* *Manihot esculenta* Crantz; S

Phyllanthus amarus Schumach. & Thonn.; H

Phyllanthus reticulatus Poir

Suregada zanzibariensis Baill.; S

FLACOURTIACEAE

Xylotheca tettensis (Kl.) Gilg; S

LAURACEAE

Cassytha filiformis L.; C

MALVACEAE

Abelmoschus esculentus (L.) Moench

Abutilon mauritianum (Jacq.) Medic.; H/S

Malvastrum coromandelianum; H

MIMOSACEAE

Dichrostachys cinerea (L.) Wight & Arn.; S

Mimosa pudica L

* *Pithecelobium dulce* (Roxb.) Benth.; T

* *Leucaena leucocepha* (Lam.) De Wild

MELIACEAE

* *Melia azaderach* L

MORACEAE

Maclura africana (Bureau) corner; S/T (C)

MORINGACEAE

* *Moringa oleifera* Lam

MYRTACEAE

Eucalyptus spp

* *Psidium guajava* L.; S/T

NYCTAGINACEAE

Boerhavia erecta L.; H

NYMPHAEACEAE

Nymphaea sp.; H

ONAGRACEAE

Ludwigia jussiaeoides Desr.; S

PAPILIONACEA (Gillett *et al.* 1970)

Aeschynomene indica L; H/S

Crotalaria laburnoides Klotzsch; H

Crotalaria retusa L. var. *retusa*; H

Dalbergia melanoxylon melanoxylon Guill. & Pear.; T

Dalbergia vacciniifolia Vatke; C

Desmodium triflorum (L.) DC.; H

Indigofera tinctoria L.; H/S

Rhynchosia minima (L.) DC.; C

Tephrosia villosa (L.) Pers.; H/S

* *Vigna unguiculata* (L.) Warp.; H/S

RUBIACEAE

Catunaregam spinosa (Thunb.) Tirvengadum; S

Kohautia virgata (Willd.) Brem.; H

Lamphrothamnus zanguebaricus Hiern; S

SAPINDACEAE

Deinbollia borbonica Scheff.; S

SIMAROUBACEAE

Harrisonia abyssinica Oliv.; S(T)

SOLANACEAE

* *Lycopersicon esculentum* L.; H

Solanum incanum L.; S

STERCULIACEAE

Sterculia africana (Lour.) Fiori; T

TILIACEAE

Carpodiptera africana Mast.; S/T

Grewia microcarpa K. Schum.; S/T

Waltheria indica L. ; S/H

VERBENACEAE

Clerodendrum rotundifolia S

b. Monocots

For Monocots these abbreviations are used for growth forms: P = Perennial; A = Annual

ARACEAE

* *Colocasia esculenta* (L.) Schott; P

BROMELIACEAE

* *Ananas comosus* (L.) Merr.; P

COMMELINACEAE

Commelina bengalensis L.; A

CYPERACEAE (Lee K. 1983)

Cyperus exaltalus Retz.; P

Cyperus prolifer Lam.; P

Fimbristylis littoralis Gaud.; A

Fuirena ciliaris (L.) Roxb.; P

GRAMINEAE (Grass Family: Clayton *et al.* 1970-1982)

Aristida adscensionis L.;

Cynodon dactylon (L.) Pers.; A

Dactyloctenium aegyptium (L.) Willd.; P

Digitaria milanjiana (Rendle) Stapf; P

Echinochloa colona (L.) Link; A/P

Eleusine indica L,; P

Eragrostis ciliaris (L.) R.Br.; A

Heteropogon contortus (L.) Roem. & Schult.; P

Hyparrhenia rufa (Nees) Stapf; P

Leptochloa panicea (Retz.) Ohwi; A

Panicum maximum Jacq.; P

* *Pennisetum purpureum* Schum.; P

* *Saccharum officinarum* L.; P

MUSACEAE

* *Musa paradisiaca* l.; p

Mussa spp.

PALMAE

* *Cocos nucifera* L.; T

TYPHACEAE

Typha domingensis Pers.; P

Typha capensis (also occurs in swamps in Dar es Salaam)

PTERIDOPHY (Ferns) (Schelpe, 1970)

ADIANTACEAE

Ceratopteris thalictroides (L.) Brongn.; A

13.2 Fauna

13.2.1 Materials and Methodology

Survey sites were selected from four representative habitats within the study area; namely the farm areas to the north-west and south-east of the main quarry site, the flood plain along Tegeta river, and the habitats immediately around the quarry site itself. The vegetation of these study sites has been described in some detail in the previous section.

Two methods were employed; namely:

1. straight-line drift fences and pitfall traps.
2. time-constrained visual encounter survey (VES).

In some cases, unstructured surveys were also conducted and comments obtained from local residents as appropriate.

Straight-line fences are short barriers that direct animals travelling on the ground into traps aligned along the fence (see Figure 13-2). The fence itself was made up of polyethylene sheeting held erect by wooden stakes, while the traps consisted of 20 litre plastic buckets buried in the ground. Traps were set 5 metres apart and each drift fence line contained 10-13 traps. The layout of the drift fences and pitfall traps was designed for maximum capture of traversing animals.

Drift fences and traps are suitable for capturing small vertebrates and non-flying invertebrates. It is not a suitable method for capturing large animals, strong jumpers or climbers. The technique has proven valuable for determining species richness, species relative abundance, and to detect the presence of rare species. For security reasons, drift fences and pitfall traps were not used in this survey in the habitats around the quarries.

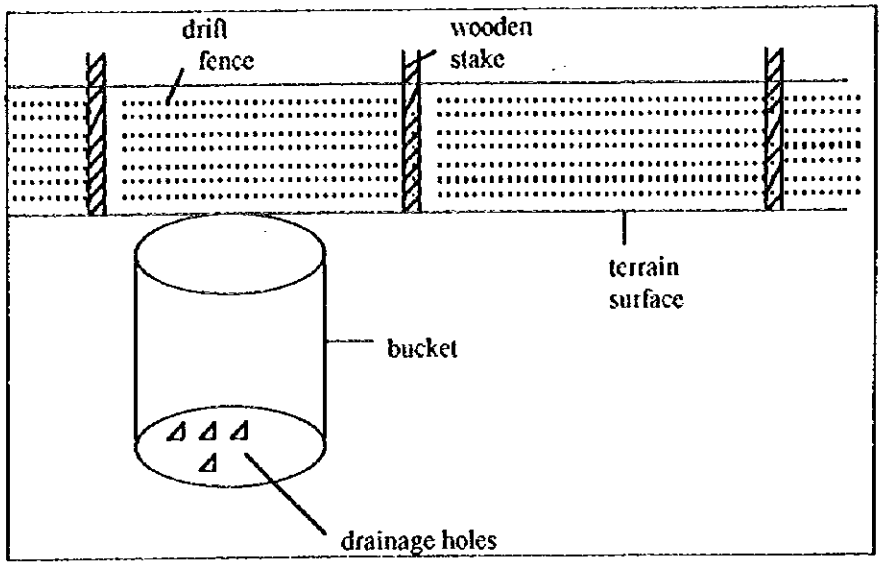


Figure 13-2: Arrangement of drift fences and pitfall traps

A time-constrained visual encounter survey (VES) consists of a search conducted over a limited period for certain species within one type of habitat. In this case, the number of bird species were surveyed over a one hour period for each of the selected sites except where indicated otherwise in the text.

13.2.2 Results

a. Farm Areas in the North-west

Animal species were trapped and recorded (using drift fences and pitfall traps) in farms located in the north-western parts of the study area on the outskirts of Salasala village over a period of four successive days. The results are shown in Figure 13-3.

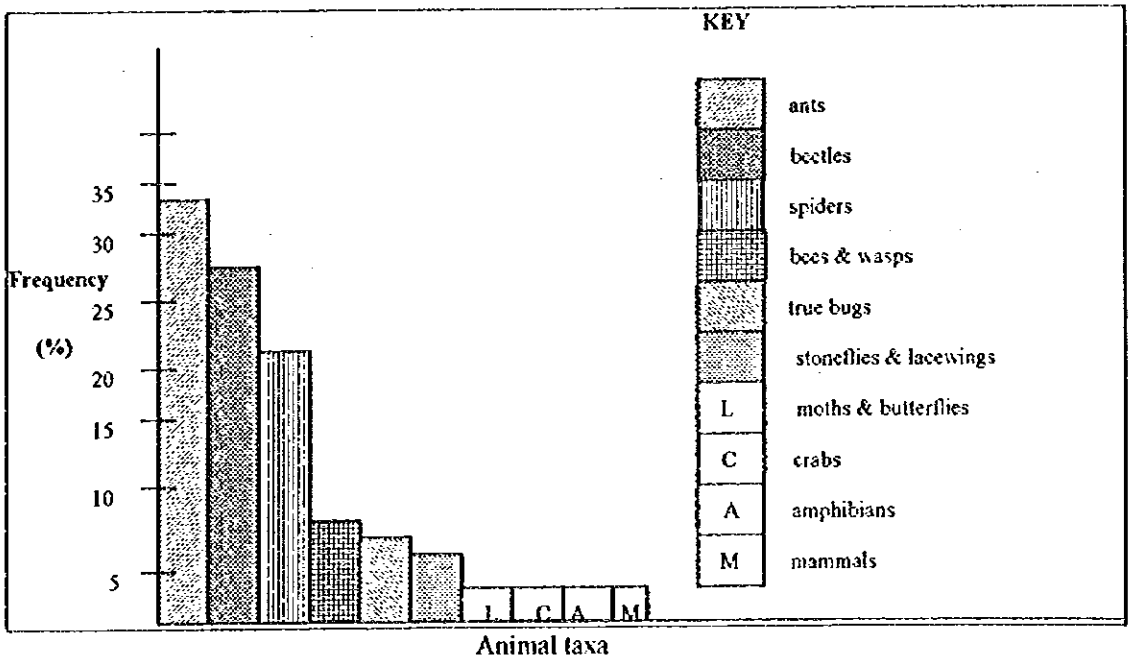


Figure 13-3: Cumulative frequency distribution of animal taxa in the N-W farms

Figure 13-3 shows that the frequency with which animal groups were "caught" and recorded in pitfall traps decreases in the order: ants, beetles, spiders, bees and wasps, true bugs, stoneflies and lacewings, moths and butterflies, crabs, amphibians and mammals.

A VES search was conducted over a period of one hour in the same type of habitats of Salasala and revealed the bird species shown in Table 13-1.

Table 13-1: Relative abundance of bird species in N-W farms

Species	No. of Birds
Hamerkop (*Scopus umbretta*)	1
Black Kite (*Milvus migrans*)	3
Wood Sandpiper (*Tringa glareola*)	1
Marsh Sandpiper (*T. stagnatilis*)	1
Tambourine Dove (*Turtur tympanistria*)	1
Pygmy Kingfisher (*Ipsida picta*)	1
Common Bulbul (*Pycnonotus barbatus*)	4
Carmine Bee-eater (*Merops nubicus*)	3
Zitting Cisticola (*Cisticola juncidis*)	1
African Firefinch (*Lagonostricta rubricata*)	3
Red-billed Firefinch (*L. Senega*)	7
Bronze Manikin (*Lonchura cucullata*)	6

Unstructured surveys in the plantations of Salasala revealed the presence of the yellow-headed gekho (*Lagodactylus spp*), robust/striated gekho (*Mabuya striata*), millipedes, monitor lizard and banded mongoose (*Mungos mungo,*).

Wetlands in the farms and adjacent areas contained viable populations of tilapia (*Oreochromis spp*) and catfish (*Clarius mossambica*) and a host of unidentified water insects.

Other animals which are said to be common during the rainy season include garter snakes (*Psammophis*), black mambas, green mambas, spitting cobras, and the African puff adder (*Bitis ariens*).

b. Farm Areas in the South-east

The cumulative frequency distribution of animal species recorded in irrigated farms in the south-eastern part of the survey area (Kilongawimo village) over a period of four days of successive trapping (using drift fences and pitfall traps) is shown in Figure 13-4.

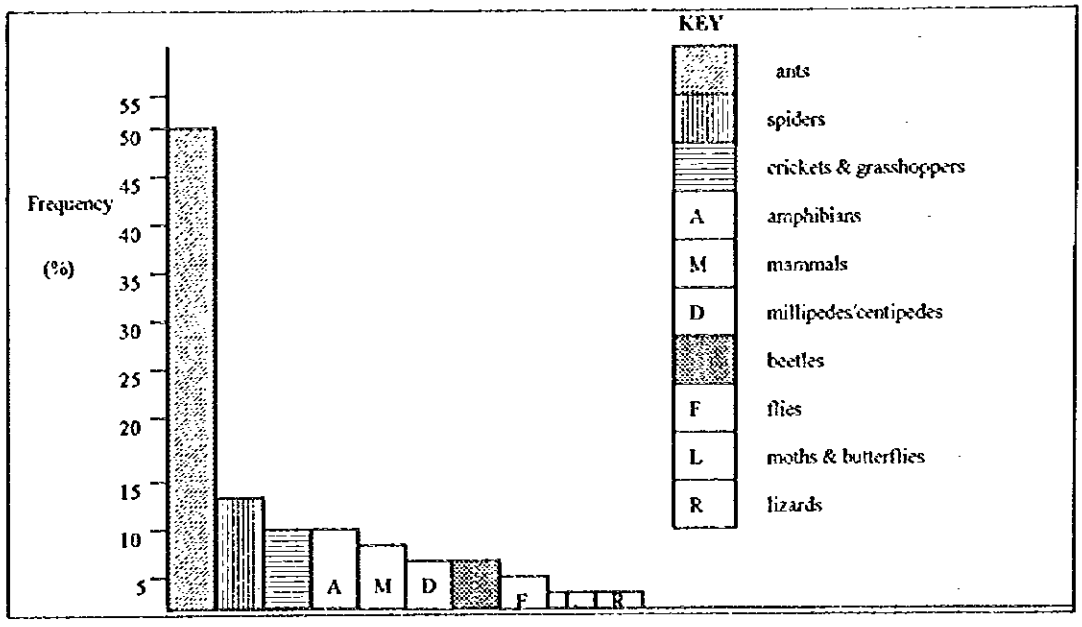


Figure 13-4: Cumulative frequency distribution of animal taxa trapped in Kilongawimo village at the Mbezi/Mtongani boundaries.

Table 13-2 shows the list of birds and their relative abundance recorded over a period of one hour at the same survey site using the VES method.

Table 13-2: Relative abundance of bird species in S-E farms

Species	No. of Birds
Cattle Egret (*Bubulcus ibis*)	2
Grey Heron (*Ardea Cinerea*)	1
Ring-necked Dove (*Streptopelia capicola*)	3
Red-eyed Dove (*S. semitorquata*)	1
Tambourine Dove (*Turtur tympanistria*)	2
Yellow-collared Lovebird (*Agapornis personata*)	2
Brown-headed Parrot (*Poicephalus cryptoxanthus*)	2
African Golden Oriole (*Oriolus auratus*)	1
Brown-hooded Kingfisher (*Halcyon elbiventris*)	2
Indian House Crow (*Corvus splendens*)	9
Fitting Cisticola (*Cisticola juncidis*)	1
Common Bulbul (*Pycnonotus barbatus*)	60
Spotted Flycatcher (*Muscicapa striate*)	3
Sulphur-breasted Shrike (*Malaconontus sulfureopectus*)	1
Black-headed tchgra (*Tchagra senegala*)	1
Scarlet-chested sunbird (*Nectarinia senegalensis*)	2
Bronze Mannikin (*Lonchura cucullata*)	1
Grey-headed Sparrow (*Passer griseus*)	1
African Firefinch (*Lagonostricta rubricata*)	2

Other animals which were sighted in the plantations include amphibian tadpoles (*Ptychadena spp*), striated gekho (*Mabuyu striata*), yellow-headed gekho (*Lagodactylus spp*), dung beetles, (*Coleoptera*) slugs, butterflies and moths,

(*Lepidoptera*) termites, a large population of fruit flies (*Diptera*), and dwarf mongoose (*Helogale parvula*).

c. Tegeta River Area

Animals caught in the Tegeta river survey area (drift fences and pitfall traps) are shown in Figure 13-5.

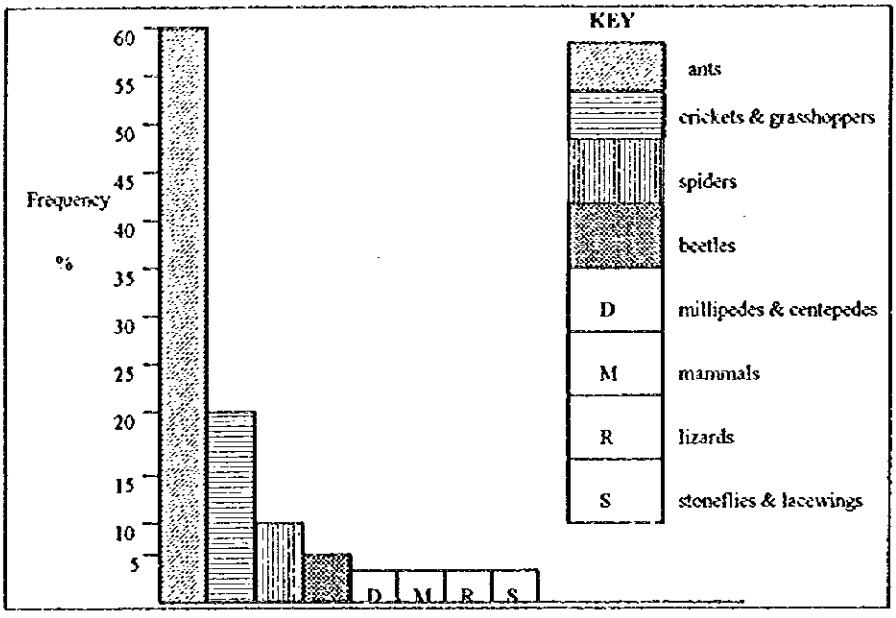


Figure 13-5: Cumulative frequency distribution of animal taxa trapped in the Tegeta river area

No VES search was conducted in this survey area.

d. Quarry Site and Adjacent Habitats

As explained in the previous section, the presence of miners in the quarry site prevented the setting of drift fences and pitfall traps as these precious items would have been removed or vandalised in a very short time.

Instead, the VES method was used to generate information. A list of animal taxa sighted inside and on the rims of the quarries as well as their relative abundance is shown in Table 13-3. In this table, any animal group was categorised as "very abundant", "abundant", or "few" when it was encountered more than five times, five times, or less than five times respectively.

Table 13-3: A list of Animal Taxa within the Quarry site

Animal	Relative Abundance
ants	abundant
aphids	very abundant
beetles	abundant
butterflies	few
wasps/bees	few
termites	very abundant
spiders	few
millipedes	few
flies (Diptera)	abundant
grasshoppers/leaf hoppers	abundant
antlions (Neuroptera)	abundant
lizards	few

A VES search of the bird fauna within the quarry site and its adjacent habitats showed the species and their relative abundance as indicated in Table 13-4.

Table 13-4: Relative abundance of bird species within the quarry site and its adjacent habitats

Species	No. of Bird
Black Kite (*Milvus migrans*)	3
Klaas' Cuckoo (*Chrysococcyx klaas*)	1
Carmine Bee-eater (*Merops nubicus*)	3
Blue-checked Bee-eater (*M. persicus*)	6
House Sparrow (*Passer domesticus*)	2
Fitting Cisticola (*Cisticola juncidis*)	2
Grey-headed Sparrow (*Passer griseus*)	4
Red-billed Quelea (*Quelea quelea*)	1

14 Public Health

14.1 Introduction

The proposed landfill is situated in Kunduchi ward which is a rural part of Kinondoni district. Kinondoni district is the most populated district in DSM with an estimated population of 948,420 in 1996[4]. Kunduchi ward has a total area of 53.6 sq. km. and estimated 1996 population of 38,785, equivalent to a population density of 724 persons/sq. km.

In this survey, data was collected from the nearest dispensary to the disposal site at Kunduchi Mtongani and for Kinondoni district.

14.2 Occurrence and Incidence of Diseases

The occurrence and incidence of diseases amongst residents in the Kunduchi Mtongani area are shown in Table 14-1 and Figure 14-1. The three most common diseases are malaria (58.3%), sexually transmitted diseases (STDs) (10.4%), and wounds (9.7%).

Comparative data for Kinondoni district is presented in Table 14-2 and Figure 14-2.

Table 14-1: Reported cases of diseases at Kunduchi Mtongani dispensary in 1996

Type of disease	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	% of total
Malaria	170	220	155	200	185	270	150	190	220	280	300	305	2645	58.3
Diarrhoea	30	15	23	40	15	35	40	36	29	30	27	37	357	7.9
Worm Infections	4	1	13	17	3	10	12	10	12	14	7	8	111	2.4
Skin Diseases	7	8	4	6	5	4	1	12	11	9	4	4	75	1.6
Eye Diseases	2	2	2	4	10	7	11	1	3	7	9	15	73	1.6
Wounds	30	20	36	45	40	33	50	48	30	38	39	30	439	9.7
STDs	18	30	40	60	57	46	53	60	27	30	35	18	474	10.4
Pneumonia	20	31	23	53	46	32	44	19	30	28	18	22	366	8.1
Total	**281**	**327**	**296**	**425**	**361**	**437**	**361**	**376**	**362**	**436**	**439**	**439**	**4540**	**100**

Table 14-2: Reported cases of diseases in hospitals/dispensaries of Kinondoni district in 1995

Type of disease	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	% of total
Malaria	17,490	15910	17,013	13,091	14,902	15,730	14,523	14,967	16,723	15,842	14,360	15,151	185,702	62.96
Diarrhoea	5930	5769	6035	4477	6476	5201	4704	3777	4390	4946	4351	5210	59516	20.18
Skin diseases	2788	3054	3018	2315	2392	2594	2178	2166	2670	4991	2735	2174	33075	11.20
Eye diseases	2551	1753	1508	925	900	984	1,454	1271	1273	1233	1202	1326	16380	5.55
Typhoid	0	0	0	0	0	0	0	0	50	0	50	0	100	0.03
Measles	15	26	23	22	18	24	15	20		29	20	11	243	0.08
Total	28,824	26512	27,597	20830	22888	24533	22874	22201	25078	27041	22670	23872	294920	100

[4] Source: population projection in this Study

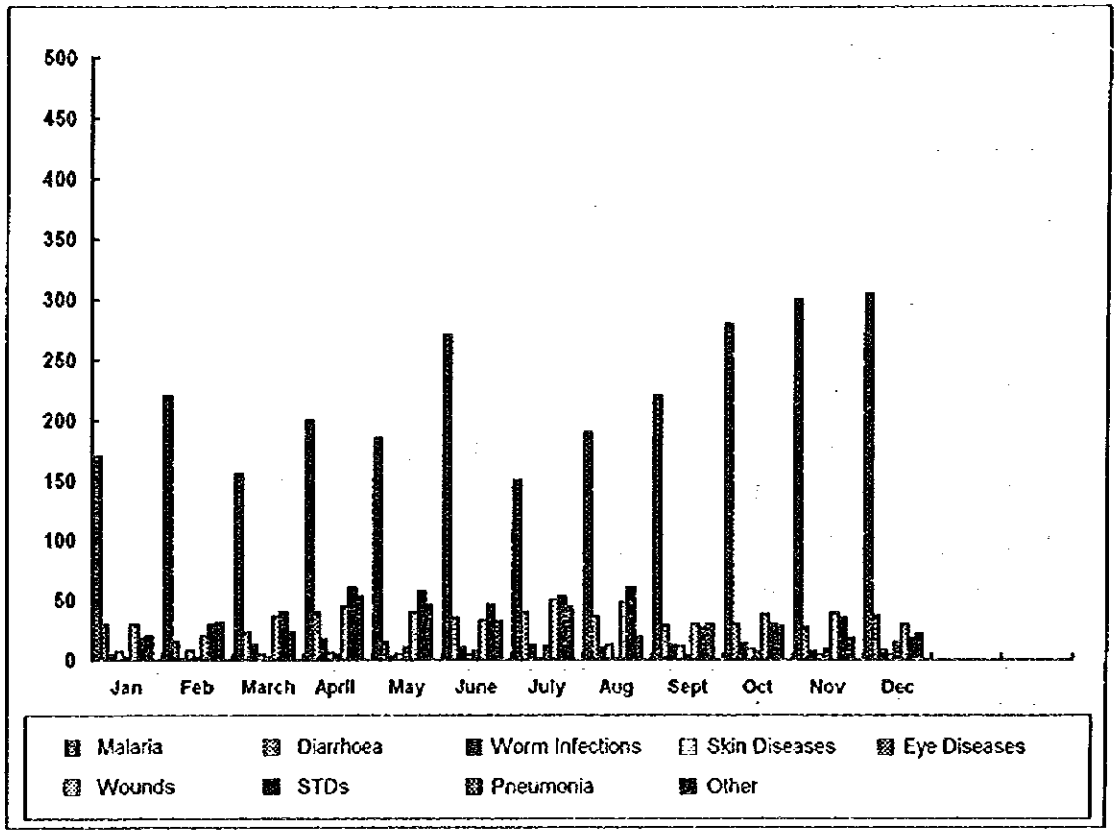


Figure 14-1: Reported cases at Kunduchi Mtongani dispensary in 1996

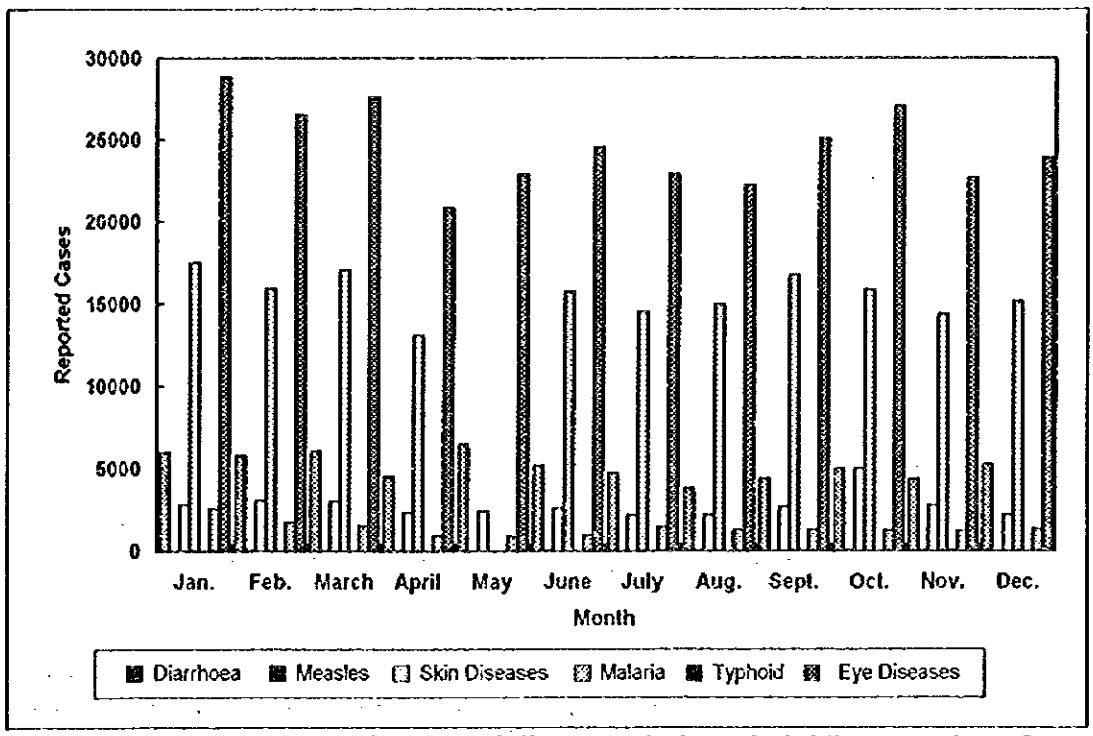


Figure 14-2: Reported cases of diseases in hospitals/dispensaries of Kinondoni District in 1995

15 Economic Survey

15.1 Introduction

The economic survey was conducted for the purpose of assessing the economic impacts to be caused by the development of a new landfill site at New MECCO quarry (Kunduchi). The major objectives of this survey were:

1. to determine the status and scale of the mining operations within the boundaries of the proposed disposal site.
2. to determine the number of individual workers whose work will be affected by the disposal site and the type and scale of economic activities they are engaged in.
3. to assess the impact on the recycling system of shifting the disposal site from Vinguguti to the Kunduchi site.

15.2 Status and scale of mining activities within the proposed landfill site and its environs

The proposed site for the landfill is within the area declared for mining activities. The land is owned by the Government and is under the control of the Ministry of Energy and Minerals which has leased most of the mining rights to MECCO. Several other private companies have also been leased mining rights (refer Figure 12-1) for areas surrounding the proposed site. This survey has identified eight companies operating within and around the proposed landfill site. These companies are:

- TANGEM
- National Service
- MALI Ltd.
- New MECCO claim
- Daffi Castro (acquired from Y. M. Chavda)
- A.PEA
- KONOIKE Construction (acquired from TACONA)
- TSSQ

Although substantial parts of the study area have already been excavated for coralline limestones, mining activities continue at a low level within the study area and this is the major economic activity taking place.

There are two main mining methods used. The first involves the use of heavy equipment like earth movers and stone crushing plants. In the study area, only three companies employ this technique; namely, MECCO, National Service (JKT) and Konoike. The second type of mining method is used by small scale miners who excavate the stones manually and do not use stone crushers.

15.2.1 Company Mining Operations

Only some of the 8 companies listed above were willing to provide information concerning the quantity of crushed stones obtained monthly and corresponding income. Crushed stones production rates were in the range of 1,200 - 15,000 tonnes per month while incomes ranged from Tsh 2,000,000 - 4,000,000 per month.

All these companies are required to pay taxes to the government depending on the size of the site they are operating and the income generated through mining activities. Table 15-1 presents the available data for the revenue collected by the Ministry of Works from the mining companies currently operating within and around the proposed landfill site.

Table 15-1: Tax collected from mining companies

Company	Revenue (Tsh/year)
TANGEM	840,000
National Service	120,000
MALI	390,000
New MECCO claims	540,000
Daffi Castro	450,000
A. PEA	30,000
KONOIKE	820,000
TSSQ	3,000,000
Total	**6,190,000**

15.2.2 Small Scale Mining and Related Activities

a. Small Scale Mining Population Analysis

A site survey was conducted of the proposed disposal site and its environs. It was estimated that the total number of miners engaged in small scale mining activities is 326. A questionnaire interview survey was conducted with 69 miners, representing 21% of the estimated miner population. The results of this survey are presented below.

The population breakdown by age and sex is presented in Table 15-2.

Table 15-2: Small Scale Miners - Population break down

Age group	Male	Female	Total	%
11-20	4	3	7	10
21 - 30	22	5	27	39
31 - 40	15	9	24	35
41 - 50	3	5	8	12
51 - 60	2	1	3	4
Total	**46**	**23**	**69**	**100**
%	**67**	**33**	**100**	

Table 15-2 shows that the percentage of female small scale miners (33%) is significantly less than male (67%). The majority of miners (74%) are aged between 21 - 40 years. The survey further indicated that most of the miners (about 68%) have been engaged in this activity for a period ranging from 1-9 years. The majority of them opted for this business because it was the only available and reliable means of income generation to them.

b. Miner Productivity

Income generated from individual small scale mining activities is normally dictated by the amount of materials (stones) crushed. Analysis of the questionnaire indicated that most of the miners (97%) normally work from 7 to 10 hours per day. Stone crushing is mostly performed manually while about 16% of all miners use explosives to break-up stones.

Table 15-3 shows that 61% of small scale miners produce 5 - 20 tins/day of crushed stones. The use of explosives greatly increases miner productivity to 100 - 200 tins/day.

Table 15-3: Small Scale Miner Productivity

Amount of crushed stones (tins/day)	Number of small scale miners	%	Crushing method
5-10	23	33.3	Manual
11-15	15	2.7	Manual
16 - 20	17	24.6	Manual
21 - 25	2	2.9	Manual
26 - 30	1	1.4	Manual
100 - 200	11	15.9	Explosive
Total	**69**	**100**	

Further analysis of the questionnaire results indicated that the construction industry provides a guaranteed market for crushed stones. Some small scale miners sell their products to middlemen but the majority of them sell their crushed stones to tip truck drivers who in turn transport and sell the stones to end users. Prices of crushed stones varies from Tsh 50 - 150 per tin (when sold to middlemen) while 7 tonne tipper trucks will sell a truckload of crushed stones for Tsh 15,000 - 45,000.

c. Income Generation

94% of the interviewed miners rely entirely on stone crushing as a means of income generation, while the remaining 6% carry out additional activities such as small scale farming and petty trading. Income generation results from small scale mining activities are presented in Table 15-4.

Table 15-4: Income generation of small scale miners

Income per month	No. of small scale miners	%
20,000 - 30,000	23	33
31,000 - 40,000	23	33
41,000 - 50,000	8	12
51,000 - 100,000	15	22
Total	**69**	**100**

d. Food Vending Activities

A site survey at New MECCO Quarry and its environs revealed that there are 26 stalls (huts) used by food vendors to render services to small scale miners and truck drivers within or near to the proposed disposal site. 20 stalls are located at A.PEA's site, 4 at MALI's and 1 at New MECCO claims. A questionnaire interview survey was conducted with 12 of these food vendors.

92% of the interviewed food vendors claimed to depend on food vending as their sole means of income generation while 8% of the vendors are also engaged in other activities. Monthly incomes ranged from Tsh 20,000 - 50,000, with the highest figure of 50,000 Tsh being greater than the minimum official salary (Tsh 30,000) for civil and public servants. The results of income generation from food vending activities are presented in Table 15-5.

Table 15-5: Monthly income of food vendors

Income per month	Number of food vendors interviewed	%
20,000 - 30,000	2	17
31,000 - 40,000	4	33
41,000 - 50,000	6	50
Total	12	100

15.3 Waste Recycling and Scavenging activities

Solid waste recycling in DSM has been identified to be taking place at 5 points in the waste stream. The identified points are at generation, collection, discharge, illegal dumping sites and at the final disposal site at Vingunguti. The closure of the current disposal site and shifting of waste disposal operations to the proposed new landfill at the New MECCO quarry site will affect recycling and scavenging activities currently taking place at the Vingunguti disposal site, because scavenging within the proposed landfill will be prohibited. This prohibition will not only affect those scavengers currently operating at the Vingunguti site but also middlemen who obtain recycled waste materials from Vingunguti and the end users of various recycled items from the disposal site.

A number of surveys were conducted by the JICA Study Team from May - September, 1996 in order to understand the present waste recycling system and scavenging activities in DSM. The results of these surveys which apply to such activities taking place at the Vingunguti disposal site are presented in the following sections.

15.3.1 Scavenger Attendance at Vingunguti disposal site

A scavenger attendance survey was carried out for 7 days from June 18 - 24, 1996 at Vingunguti disposal site with attendance being recorded three times per day in the morning, afternoon and evening. Table 15-6 presents the results of this survey.

Table 15-6: Attendance of Scavengers at Vingunguti

TIME	Date							Average
	TUES 18/6	WED 19/6	THUR 20/6	FRI 21/6	SAT 22/6	SUN 23/6	MON 24/6	
Morning	92	61	68	54	46	46	51	60
Afternoon	51	35	58	44	40	28	34	41
Evening	23	33	39	45	32	31	30	33
Total	166	129	165	143	118	105	115	134
Average	55	43	55	48	39	35	38	45

The average attendance of scavengers at Vingunguti disposal site was found to be 60, 41 and 33 during mornings, afternoons and evenings respectively. The overall average,

corresponding to the average number of scavengers present at any one time during the day was 45.

15.3.2 Items collected by scavengers

The different items collected have been categorised into four groups according to the number of scavengers collecting each item, as shown in Table 15-7. Items normally collected and which are easy to sell to either middlemen or directly to end users are tins/cans, papers, glass, bottles, sacks, food leftovers, etc.

Table 15-7: Number of scavengers collecting different items at Vingunguti disposal site

Category	No. of Scavengers	Items collected
Very high	140 - 200	Cans/tins, paper
High	80 - 110	Glass bottles, Plastics bottles, sacks, other metals (i.e. not cans/tins)
Medium	30 - 50	Food leftovers, cereals, wire mesh, wooden materials
Low	0 - 20	Other glass (i.e. not bottles) plastic sheets, paints, sawdust, textiles, tyres

15.3.3 Scavenger Interview Survey at Vingunguti disposal site

A survey of 30 permanent scavengers at Vingunguti disposal site was conducted in order to gather various information related to scavenging activities at the disposal site. The results of this survey are presented below.

Most of the interviewed scavengers (80%) were aged between 20 - 39 years and 60% of them had been engaged in this business for 6 - 12 years. There is a large demand for all the items sorted at the disposal site and sorted materials are normally sold to middlemen operating in the immediate vicinity of the dump site. 90% of interviewed scavengers work for 8 - 12 hours per day and 60% of the interviewed scavengers earn a monthly income of Tsh 6,000 - 10,000 (average Tsh 11,500) which is lower than the minimum official monthly salary of Tsh 30,000. The distribution in monthly income for scavengers at the disposal site is presented in Table 15-8.

Table 15-8: Distribution in monthly income for scavengers at Vingunguti disposal site

Monthly income	No. of scavengers	%
1,000 - 5,000	2	7
6,000 - 10,000	18	60
11,000 - 15,000	5	17
16,000 - 20,000	4	13
21,000 - 25,000	1	3
Total	30	100

To calculate the total income generated by scavenger activities it was assumed that scavengers spend 8 hours/day at the site and 2 hours/day engaged in selling their materials and undertaking other activities. From Table 15-6 it was determined that the total number of hours spent by all scavengers at the disposal site in an average week was 536 man hours. Thus, dividing by 8 hours, it can be assumed that there are 67 "full-

time" scavengers. At an average income of Tsh 11,500 per month the total income generated by scavengers per month equals Tsh 770,500.

15.3.4 Middlemen Survey at Vingunguti disposal site

This survey involved interviewing 11 middlemen operating in the immediate vicinity of Vingunguti disposal site. The monthly income generation varies from Tsh 11,000 - 70,000. The average income was estimated to be Tsh 27,300 per month. The distribution in monthly income for middlemen at Vingunguti is shown in Table 15-9.

The total number of middlemen who Vingunguti scavengers sell materials to was not determined and hence it was difficult to estimate total income derived solely from activities related the buying of materials from the Vingunguti scavengers. However, it is expected that the total income of middlemen closely corresponds with that of the scavengers.

Table 15-9: Distribution in monthly income for middlemen Vingunguti

Income (Tsh)	No. of middlemen	%
1, 000- 10,000	0	0
11,000 - 20,000	7	64
21,000 - 30,000	1	9
31,000 - 40,000	2	18
41,000 - 50,000	0	0
51,000 - 60,000	0	0
61,000 - 70,000	1	9
Total	11	100

The major source of recyclable items for the middlemen surveyed is scavengers from Vingunguti disposal site although two middlemen obtain small amounts of used materials from restaurants/hotels, refuse truck workers and households. Various tools used by middlemen at the disposal site include vehicles, especially those dealing with papers, while others use handcarts, milling machines and casual labour. Most of the middlemen sell the recycled materials directly to factories.

The middlemen buy most of the recycled items from the scavengers. Results on the prices of buying and selling recycled goods indicate that some recycled items (e.g. sacks, plastic bottles, and metals) are sold to end users at prices which are as much as 100% higher than the buying prices. The buying and selling prices for different recycled items are shown in Table 15-10.

Table 15-10: Buying and selling prices for different recycled items

Item	Unit	Price (Tsh)		No. of middlemen stating each price
		Buying	selling	
glass bottle	-	not specified	not specified	1
cans and tins	kg	150/-	200/-	1
	kg		250/-	1
	ea.		4/-	1
car batteries	kg	30/-	35/-	1
other metals	kg	10/-	15/-	1
	kg	10/-	20/-	2
	kg	10/-	25/-	1
paper (boxes	kg	15/-	25/-	7
plastic bottles	ea.	3/-	6/-	1
sacks	ea.	50/-	100/-	1

15.3.5 Amount of Recycled Waste Items at Vingunguti disposal site

The recycled waste amount from Vingunguti disposal site was estimated using three methods:

1. Scavenger Interview Survey (SIS) results for estimated quantities of different items collected by scavengers from Vingunguti disposal site.
2. Middleman Interview Survey (MIS) results for estimated quantities of different items purchased from scavengers by middlemen operating in the immediate vicinity of Vingunguti disposal site.
3. Scavenger Waste Amount Survey (SWAS) results for estimated quantities of items collected by scavengers.

These surveys' methodologies and complete results are explained in Annex 8. A summary of the results is shown in Table 15-11 below. The average quantity for each item is calculated and summed to get the total recycling amount of 2.1 t/d (range = 1.1-2.6 t/d).

Table 15-11: Comparison of Estimated Recycled Amounts for Different Items and Calculation of the Recycled Waste Amount

Unit: kg/d

Item	bo	ct	fo	hu	me	pa	pl	pt	sa	ty	wo	oth	Total
SIS	87	132	---	200	162	1256	62	6	126	15	147	---	2193
MIS	---	120	83	---	433	1765	(4)	---	(9)	---	117	41	2572
SWAS	76	165	5	75	136	233	36	34	17	7	260	29	1073
Avg.	82	139	44	138	244	1086	49	20	72	11	175	35	2095

Note: 1. Items in brackets are excluded from calculation of average amounts.
2. bo = glass bottle; ct = cans/tins; fo = food leftovers; hu = cereal/rice husks; me = other metal; pa = paper; pl = plastic; pt = paint; sa = sack; ty = tyre; wo = wood; oth = other.

Comparing the reported (SIS and MIS) and the measured amounts it appears that the reported figures are too high. Furthermore the reported amounts do not correlate with the income results of the scavenger survey. The measured survey results are considered a more reliable guide in confirming the total income from scavenging activities. Using unit costs shown in Table 15-10 and the SWAS results it was calculated that income of

Tsh 1,050,000 a month is generated from scavenging activities at Vingunguti disposal site.

15.3.6 Main Uses and End Users of Recycled Waste Items

The main uses and end users of different recycled waste items depends on the types of waste recycled. Some of the items (e.g. broken glass, metals, paper etc.) need to be reprocessed before they can be reused. The main users of various goods have been identified to include industries, individuals, petty traders, micro and large industries. Table 15-12 summarises the main uses and user of different types of recycled items, while Table 15-13 details some types of recycled materials and the main industries where they are reprocessed and recycled in DSM.

Table 15-12: Uses and major users of recycled waste items in DSM

Item	End use	User
Broken glass	- reprocessed into bottles/jars - to make security glass barrier on top of concrete walls around premises	- industries (broken bottles only) - bricklayers/construction companies
metal (cans, tins. Etc.)	- reprocessed into billets, ingots, etc. - to make household and other items - to make toys and decorations - cans/tins used for potting plants	- industries - individuals, micro industries - individuals - residents
Cereals/husks	- animal feed	- livestock owners
Drums (50 gal)	- water barrels - as property boundary markers - storage and transportation of goods	- individuals - individuals, hospitals, schools etc. - shops, traders, etc.
Food leftovers	- recooked and eaten - animal feed	- scavengers - livestock owners
Glass bottles	- reused	- individuals, shops, petty traders, markets, manufacturers of soft drinks, beer, etc.
Paper (sheets, boxes, etc.)	- reprocessed into paper products - to make paper bags - wrapping goods - printing bus tickets (paper used on one side)	- industries - markets, petty traders, micro-industries - markets, petty traders - micro-industries
Paint	- remixed and sold as new paint	- individuals
Plastic bottles	- reuse - making toys, decorations	- individuals, markets, petty traders, shops, etc. - individuals
Plastic sheets	- covering, roofing, wall materials	- individuals, markets, petty traders
Sacks	- covering, roofing, wall materials - repaired and reused	- individuals, markets, petty traders - individuals, charcoal vendors
Sawdust	- ground cover for animals	- livestock owners
Textiles	- to make cushions, pillows, mattresses	- individuals, micro-industries
Tyres	- to make bushes, sandals, bike brakes - as property boundary markers	- micro-industries - individuals, offices, etc.
Wire mesh	- to make mosquito netting, etc.	- individuals
Wood	- fire wood - carpentry/construction	- individuals, canteen - individuals, tradesmen

Table 15-13: Major recycled items and corresponding end user industries in DSM

Type of waste	Category of industry	Recycling industries (location)
Paper	Micro-industry	Dasico (Gerezani), UMIDA (Gerezani)
	Large industry	Kibo Paper (Vingunguti), Tanpak Industries Ltd. (Mikocheni)
Metal	Micro-industry	Dasico (Gerezani), UMATA (Tabata), Kilulumo Ushirika (Mburahati), name unknown (Mbagala Kizinga) and many more
	Large industry	Steelcast (Tazara), M.M. Integrated Steel Mills Ltd. (Mikocheni), Iron & Steel Ltd. (Mikocheni), ALUCO (Vingunguti), NECO (Vingunguti), Tazara workshops (Tazara)
Glass	Micro-industry	---
	Large industry	Kioo Ltd. (Chang'ombe), Pepsi Ltd. (Vingunguti), Tanzania Breweries Ltd. (Gerezani)
Plastics	Micro-industry	---
	Large industry	Simba Plastics (Chang'ombe), Tegry Plastics (Vingunguti)
Tyres	Micro-industry	name unknown (Mtambani), Mshimbula Enterprises (Bandari)
	Large industry	NAS Tyre Services Ltd-(Vingunguti) and Treadsetters, Kassam Retreads, Globe

Note: Location is indicated in brackets

16 Meteorological Data

Meteorological data is presented in Appendix 3 of this report. This data was recorded at the different meteorological stations: Tanganyika Packers (at Kawe), Wazo Hill, and the Dar es Salaam International Airport (DIA). These stations are all located within DSM city. Their respective locations are:

- Tanganyika Packers station is approximately 8 km south east of the EIA study area.
- Wazo Hill station is about 5 km north of the EIA study area.
- DIA weather station is located approximately 24 km south west of the EIA study area.

According to the Directorate of Meteorology (MET), the Tanganyika Packers and Wazo Hill stations only record rainfall data whereas the DIA meteorological station records rainfall, wind direction and speed, temperature and evaporation.

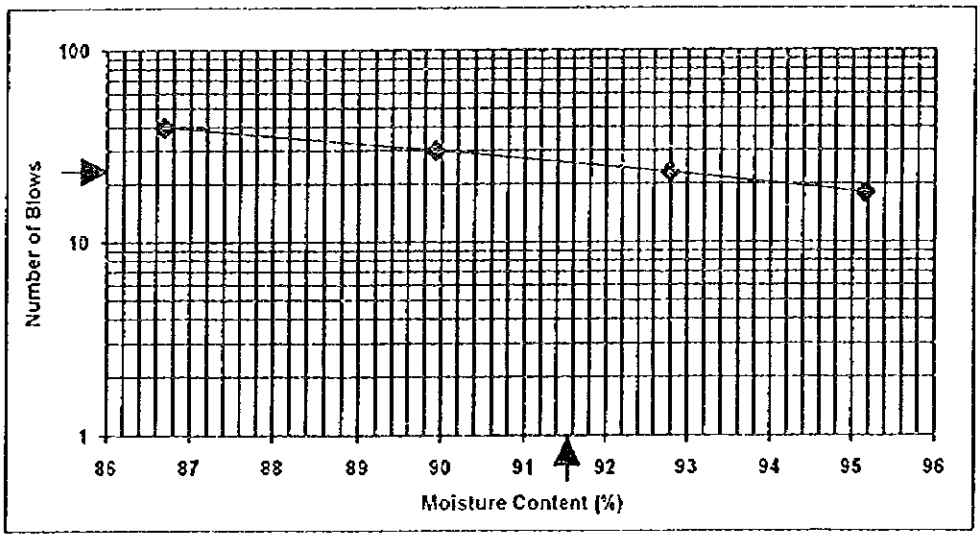
APPENDIX 1

Tabular And Graphical Presentation Of Atterberg Limits Determination Results

PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Borrow soil from Mwambisi Brick Factory - Pugu. (Bentonite clay)	
LAB. No. 1034	DATE: 20/2/97

No. OF BLOWS			40	30	23	18	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			45	62	35	80	109	36
TIN + WET SOIL	WEIGHT	GMS	51.40	44.80	47.50	42.40	23.55	22.50
TIN + DRY SOIL	WEIGHT	GMS	35.50	32.20	32.70	30.60	21.80	20.90
TIN	WEIGHT	GMS	17.16	18.19	16.75	18.20	17.10	16.60
WATER	WEIGHT	GMS	15.90	12.60	14.80	11.80	1.75	1.60
DRY SOIL	WEIGHT	GMS	18.34	14.01	15.95	12.40	4.70	4.30
MOISTURE CONTENT		%	86.69	89.93	92.79	95.16	37.23	37.20
							AVERAGE	37.23

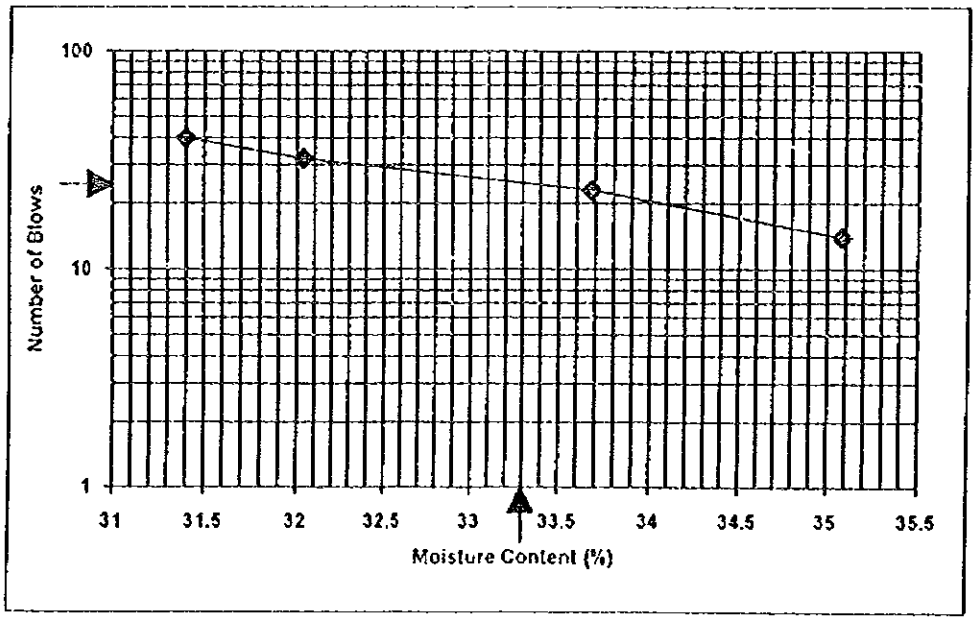
LIQUID LIMIT %	91.60
PLASTIC LIMIT %	37.23
PLASTICITY INDEX %	54.37



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Borrow soil from Kisarawe Brick Factory - Pugu. (Red clay soil)	
LAB. No. 1035	DATE: 22/2/97

No. OF BLOWS			40	32	23	14	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			1255	49	1249	27	11	20
TIN + WET SOIL	WEIGHT	GMS	44.85	55.30	61.25	64.65	21.20	21.30
TIN + DRY SOIL	WEIGHT	GMS	37.70	46.20	50.10	52.30	20.60	20.60
TIN	WEIGHT	GMS	15.00	17.80	17.00	17.10	16.40	16.50
WATER	WEIGHT	GMS	7.15	9.10	11.15	12.35	0.60	0.70
DRY SOIL	WEIGHT	GMS	22.70	28.40	33.10	35.20	4.20	4.10
MOISTURE CONTENT		%	31.40	32.04	33.68	35.08	14.28	17.07
							AVERAGE	15.67

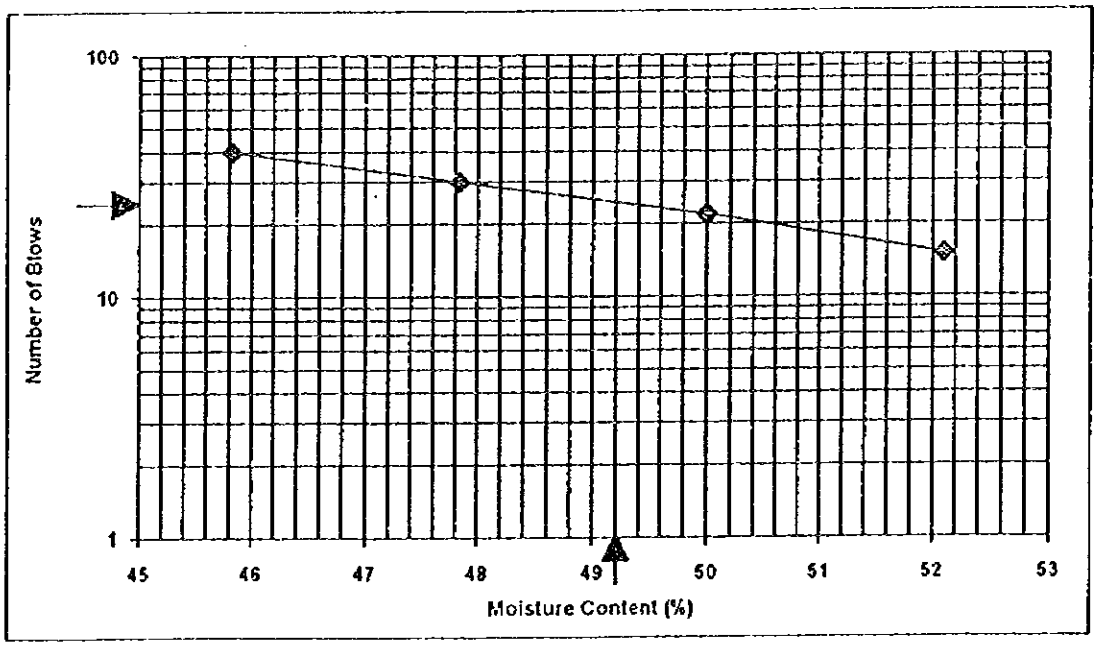
LIQUID LIMIT %	33.33
PLASTIC LIMIT %	15.67
PLASTICITY INDEX %	17.66



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Borrow soil from Kinzudi. (clay soil)	
LAB. No. 1036 (Pit 1)	DATE: 21/2/97

No. OF BLOWS			40	30	22	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			36	34	111	31	25	24
TIN + WET SOIL	WEIGHT	GMS	58.40	54.80	56.20	45.70	20.00	19.70
TIN + DRY SOIL	WEIGHT	GMS	45.20	42.60	43.10	35.80	19.40	19.15
TIN	WEIGHT	GMS	16.40	17.10	16.90	16.80	16.50	16.30
WATER	WEIGHT	GMS	13.20	12.20	13.10	9.90	0.60	0.55
DRY SOIL	WEIGHT	GMS	28.80	25.50	26.20	19.00	2.90	2.85
MOISTURE CONTENT		%	45.83	47.84	50.00	52.10	20.68	19.29
							AVERAGE	20.00

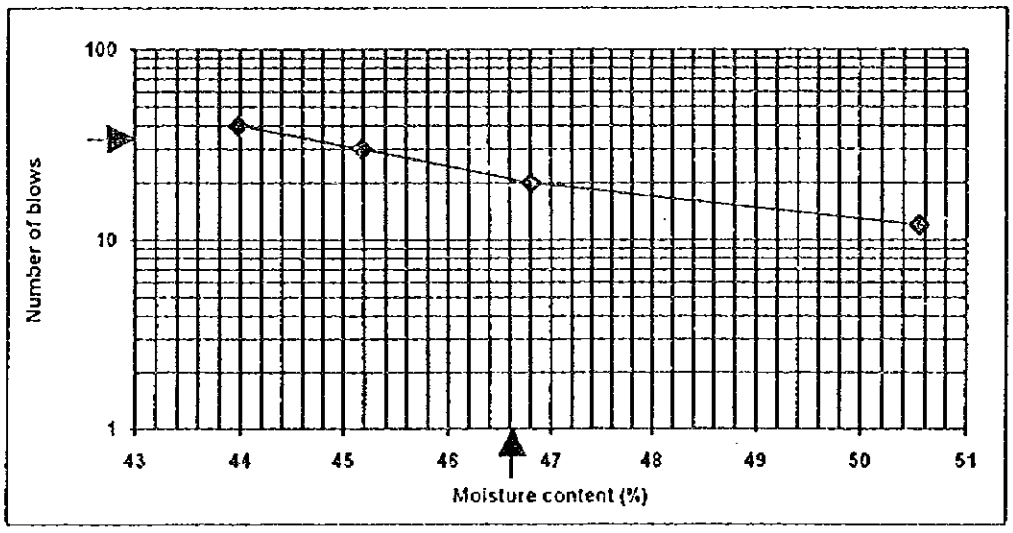
LIQUID LIMIT %	49.20
PLASTIC LIMIT %	20.0
PLASTICITY INDEX %	29.2



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Borrow soil from Kinzudi. (clay soil)	
LAB. No. 1037 (Pit 2)	DATE: 21/2/97

No. OF BLOWS			40	30	20	12	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			131	18	204	13	22	31
TIN + WET SOIL	WEIGHT	GMS	62.40	55.50	48.90	43.90	20.70	19.70
TIN + DRY SOIL	WEIGHT	GMS	48.50	43.30	38.60	34.60	19.90	19.10
TIN	WEIGHT	GMS	16.90	16.30	16.60	16.20	16.40	15.90
WATER	WEIGHT	GMS	13.90	12.20	10.30	9.30	0.80	0.60
DRY SOIL	WEIGHT	GMS	31.60	27.00	22.00	18.40	3.50	3.20
MOISTURE CONTENT		%	43.98	45.18	46.81	50.54	22.85	18.75
							AVERAGE	20.80

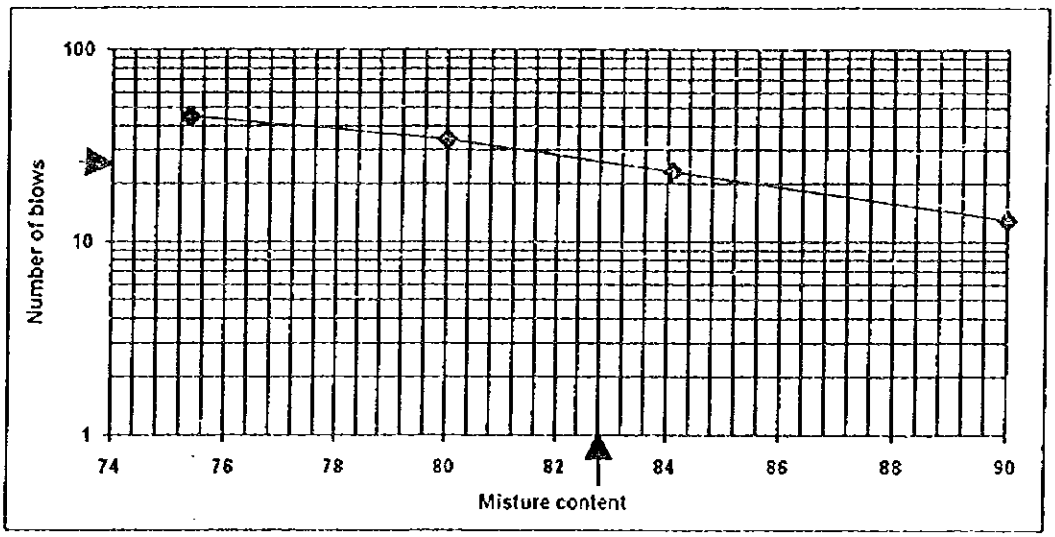
LIQUID LIMIT %	46.30
PLASTIC LIMIT %	20.80
PLASTICITY INDEX %	25.50



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 924	DATE: 29/2/97

No. OF BLOWS			45	34	23	13	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			71/31	113	202	66/135	89/71	27/105
TIN + WET SOIL	WEIGHT	GMS	41.00	37.80	41.10	39.80	23.18	23.75
TIN + DRY SOIL	WEIGHT	GMS	30.60	28.60	30.00	29.00	21.20	21.75
TIN	WEIGHT	GMS	16.80	17.10	16.80	17.00	16.65	17.00
WATER	WEIGHT	GMS	10.4	9.2	11.20	10.8	1.98	2.0
DRY SOIL	WEIGHT	GMS	13.80	11.50	13.20	12.00	4.55	4.75
MOISTURE CONTENT		%	75.36	80.00	84.09	90.00	43.51	42.10
							AVERAGE	42.80

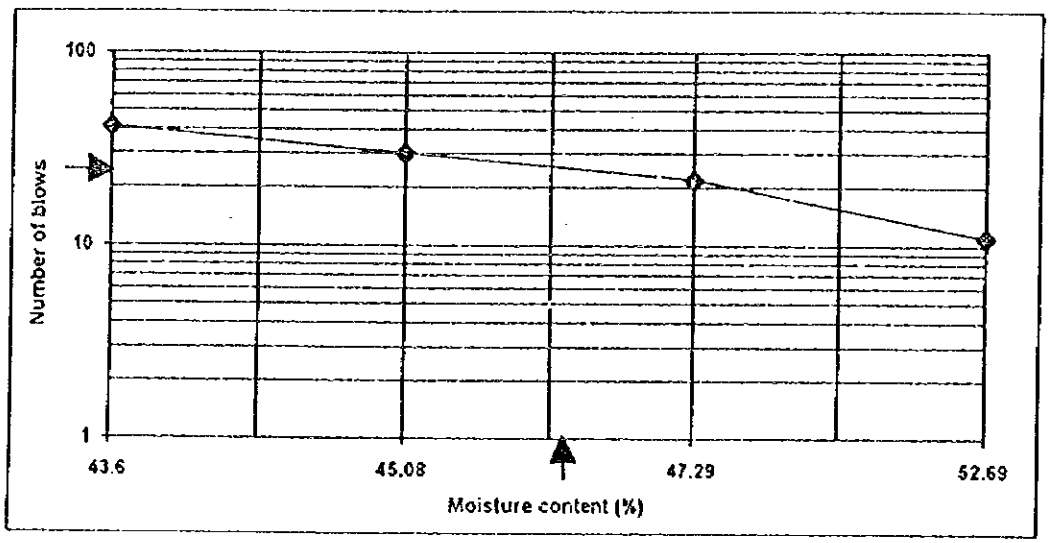
LIQUID LIMIT %	83.20
PLASTIC LIMIT %	42.80
PLASTICITY INDEX %	40.40



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 936	DATE: 29/2/97

No. OF BLOWS			41	30	22	11	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			36/95	46/81	104	100/18	52/55	22
TIN + WET SOIL	WEIGHT	GMS	47.10	45.00	43.10	51.25	25.40	23.90
TIN + DRY SOIL	WEIGHT	GMS	37.90	36.30	34.80	40.00	24.25	22.60
TIN	WEIGHT	GMS	16.80	17.00	17.25	18.65	18.30	16.75
WATER	WEIGHT	GMS	9.2	8.7	8.3	11.25	1.15	1.30
DRY SOIL	WEIGHT	GMS	21.1	19.30	17.55	21.35	5.95	5.85
MOISTURE CONTENT		%	43.60	45.08	47.29	52.69	19.33	22.22
							AVERAGE	20.78

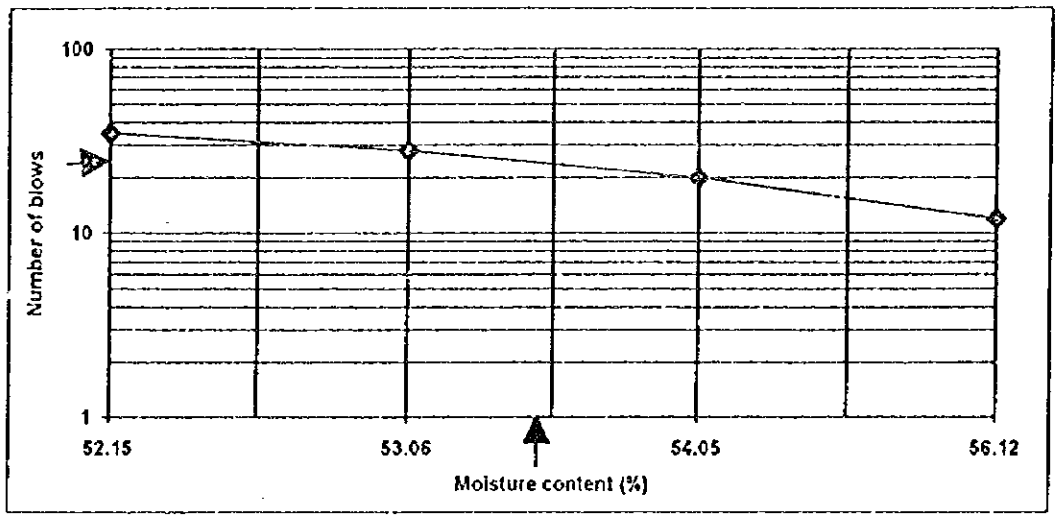
LIQUID LIMIT %	46.70
PLASTIC LIMIT %	20.78
PLASTICITY INDEX %	25.92



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 940c	DATE: 2/97

No. OF BLOWS			35	28	20	12	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			38	84	17	109	81	42
TIN + WET SOIL	WEIGHT	GMS	45.70	55.50	57.10	62.90	21.00	21.50
TIN + DRY SOIL	WEIGHT	GMS	36.00	41.50	43.10	46.40	20.20	20.40
TIN	WEIGHT	GMS	17.40	17.00	17.20	17.00	16.90	16.00
WATER	WEIGHT	GMS	9.70	13.00	14.00	16.50	0.80	1.10
DRY SOIL	WEIGHT	GMS	18.60	24.50	25.90	29.40	3.30	4.40
MOISTURE CONTENT		%	52.15	53.06	54.05	56.12	24.24	25.00
							AVERAGE	24.62

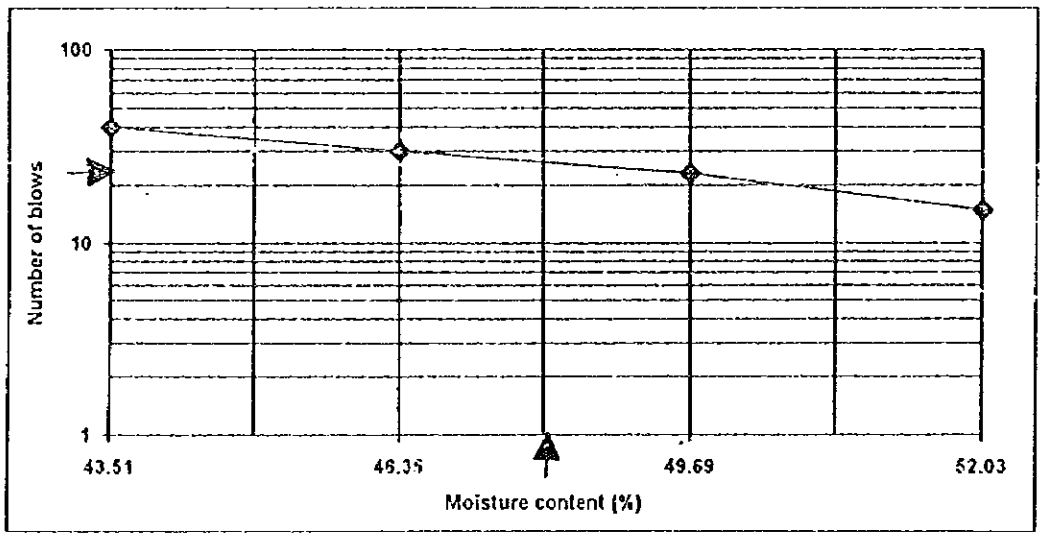
LIQUID LIMIT	%	53.40
PLASTIC LIMIT	%	24.62
PLASTICITY INDEX	%	28.78



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 945	DATE: 28/2/97

No. OF BLOWS			40	30	23	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			24/107	110	55	45/38	111	20.2
TIN + WET SOIL	WEIGHT	GMS	40.07	39.67	41.00	43.40	24.15	23.80
TIN + DRY SOIL	WEIGHT	GMS	33.00	32.30	33.00	34.45	22.35	22.35
TIN	WEIGHT	GMS	16.75	16.40	16.90	17.25	17.00	16.66
WATER	WEIGHT	GMS	7.07	7.37	8.00	8.95	1.30	1.45
DRY SOIL	WEIGHT	GMS	16.25	15.90	16.10	17.20	5.85	5.69
MOISTURE CONTENT		%	43.51	46.35	46.69	52.03	22.22	25.48
							AVERAGE	23.85

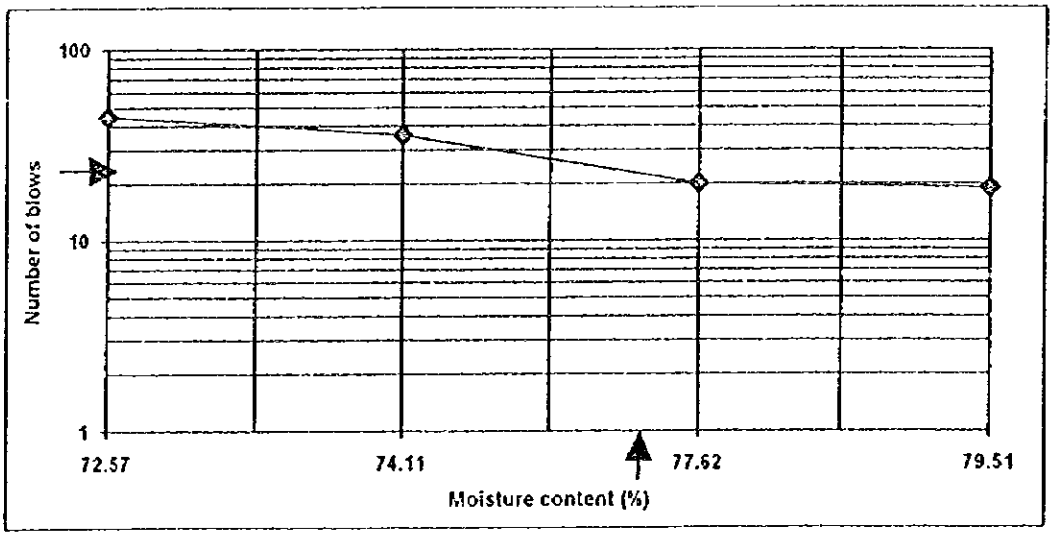
LIQUID LIMIT %	48.10
PLASTIC LIMIT %	23.85
PLASTICITY INDEX %	24.25



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 950	DATE: 2/97

No. OF BLOWS			45	36	20	18	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			65	131	111	202	35	23
TIN + WET SOIL	WEIGHT	GMS	56.30	51.20	54.60	60.80	22.46	21.80
TIN + DRY SOIL	WEIGHT	GMS	39.90	36.60	38.30	41.40	21.60	20.80
TIN	WEIGHT	GMS	17.30	16.90	17.30	17.00	18.40	17.10
WATER	WEIGHT	GMS	16.40	14.60	16.30	19.40	0.86	1.00
DRY SOIL	WEIGHT	GMS	22.60	19.70	21.00	24.40	3.20	3.70
MOISTURE CONTENT		%	72.57	74.11	77.62	79.51	26.88	27.03
							AVERAGE	26.96

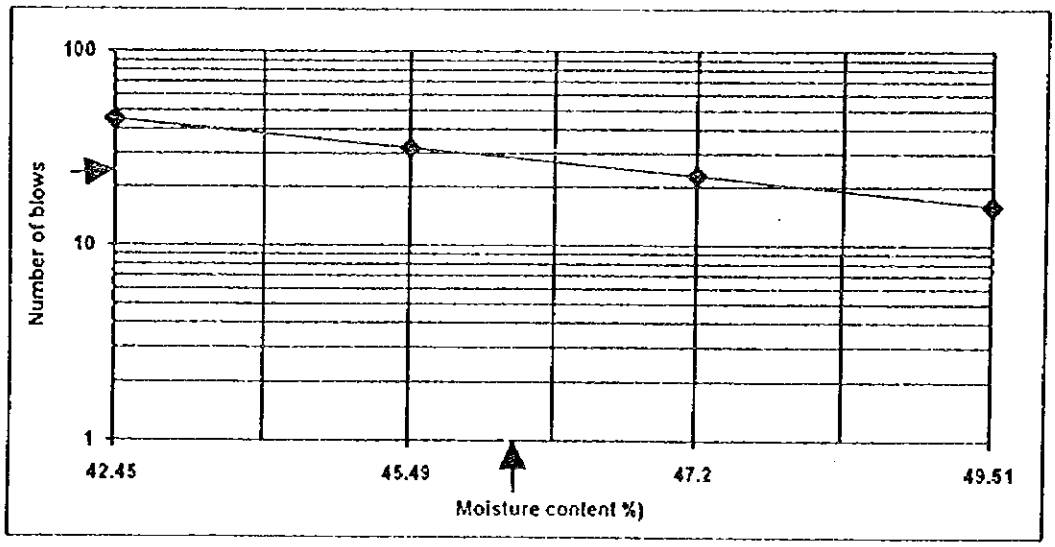
LIQUID LIMIT %	77.10
PLASTIC LIMIT %	26.96
PLASTICITY INDEX %	50.14



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 953C	DATE: 2/97

No. OF BLOWS			45	32	23	16	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			18	35	24	22	80	109
TIN + WET SOIL	WEIGHT	GMS	38.40	58.30	59.40	63.30	24.10	23.40
TIN + DRY SOIL	WEIGHT	GMS	32.50	45.70	45.90	48.00	23.10	22.30
TIN	WEIGHT	GMS	18.60	18.00	17.30	17.10	18.30	17.00
WATER	WEIGHT	GMS	5.90	12.60	13.50	15.30	1.00	1.10
DRY SOIL	WEIGHT	GMS	13.90	27.70	28.60	30.90	4.80	5.30
MOISTURE CONTENT		%	42.45	45.49	47.20	49.51	20.83	20.75
							AVERAGE	20.79

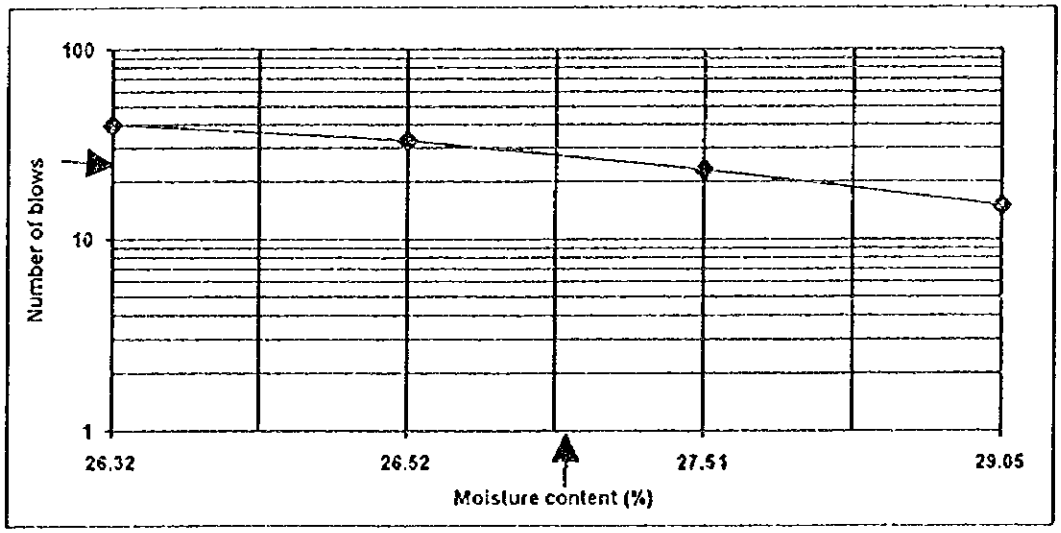
LIQUID LIMIT %	45.80
PLASTIC LIMIT %	20.79
PLASTICITY INDEX %	25.01



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 959	DATE: 2/97

No. OF BLOWS			40	33	23	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			100/33	111	17/54	38/35	81	84
TIN + WET SOIL	WEIGHT	GMS	48.20	58.80	60.30	63.60	20.00	19.50
TIN + DRY SOIL	WEIGHT	GMS	41.70	50.10	51.00	53.20	19.70	19.30
TIN	WEIGHT	GMS	17.00	17.30	17.20	17.40	16.90	17.00
WATER	WEIGHT	GMS	6.50	8.70	9.30	10.40	0.30	0.20
DRY SOIL	WEIGHT	GMS	24.70	32.80	33.80	35.80	2.80	2.30
MOISTURE CONTENT		%	26.32	26.52	27.51	29.05	10.71	8.69
							AVERAGE	9.7%

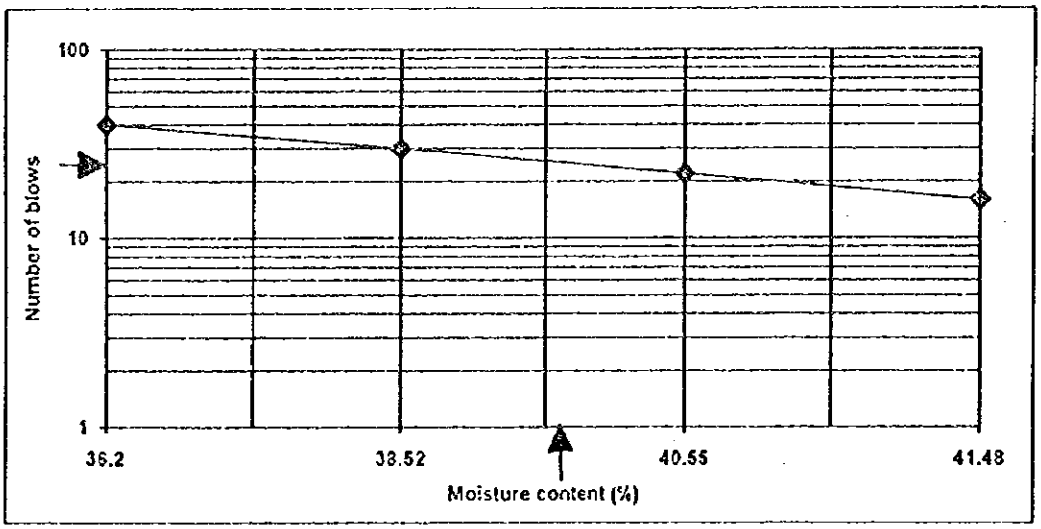
LIQUID LIMIT %	27.15
PLASTIC LIMIT %	9.70
PLASTICITY INDEX %	17.45



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 964	DATE: 2/97

No. OF BLOWS			40	30	22	16	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			41	53	39	84	81	77
TIN + WET SOIL	WEIGHT	GMS	47.30	44.90	42.50	41.80	20.80	20.90
TIN + DRY SOIL	WEIGHT	GMS	39.30	37.60	35.20	34.50	20.20	20.30
TIN	WEIGHT	GMS	17.20	18.65	17.20	16.90	16.75	16.99
WATER	WEIGHT	GMS	8.00	7.3	7.3	7.3	0.60	0.60
DRY SOIL	WEIGHT	GMS	22.1	18.95	18.00	17.6	3.45	3.31
MOISTURE CONTENT		%	36.20	38.52	40.55	41.48	17.39	18.13
							AVERAGE	17.76

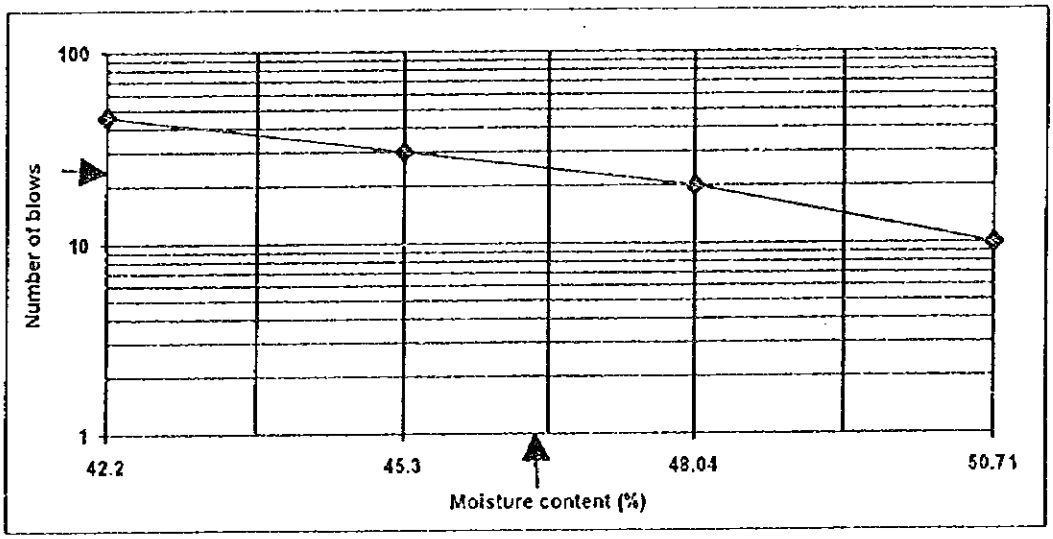
LIQUID LIMIT %	39.60
PLASTIC LIMIT %	17.76
PLASTICITY INDEX %	21.84



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 982	DATE: 2/97

No. OF BLOWS			46	30	20	10	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			111	104	77	38	17	81
TIN + WET SOIL	WEIGHT	GMS	30.45	31.00	32.00	33.40	22.50	22.15
TIN + DRY SOIL	WEIGHT	GMS	26.28	26.70	27.10	28.05	21.60	21.00
TIN	WEIGHT	GMS	16.40	17.20	16.90	17.50	17.15	16.70
WATER	WEIGHT	GMS	21.17	4.30	4.90	5.35	0.90	1.15
DRY SOIL	WEIGHT	GMS	9.88	9.50	10.20	10.55	4.45	4.30
MOISTURE CONTENT		%	42.2	45.3	48.04	50.71	20.22	26.74
							AVERAGE	23.5

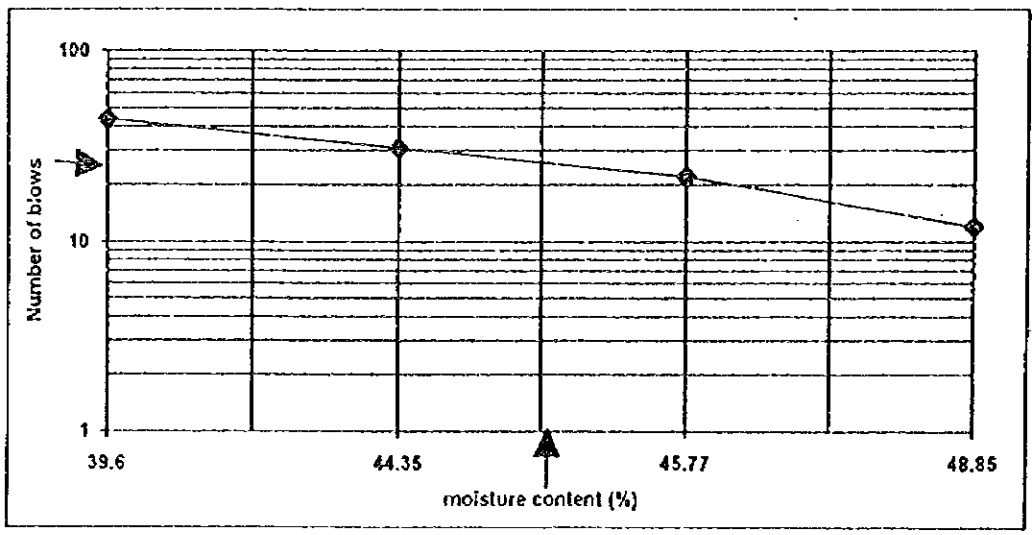
LIQUID LIMIT %	46.4
PLASTIC LIMIT %	23.5
PLASTICITY INDEX %	22.9



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 992	DATE: 6/2/97

No. OF BLOWS			44	31	22	12	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			17/18	24/107	38	41/104	45/78	80/53
TIN + WET SOIL	WEIGHT	GMS	37.90	33.50	38.00	39.90	22.80	24.30
TIN + DRY SOIL	WEIGHT	GMS	32.00	28.40	31.50	32.45	21.80	23.25
TIN	WEIGHT	GMS	17.10	16.90	17.30	17.20	17.10	18.25
WATER	WEIGHT	GMS	5.90	5.10	6.5	7.45	1.00	1.05
DRY SOIL	WEIGHT	GMS	14.9	11.50	14.2	15.25	4.7	5.0
MOISTURE CONTENT		%	39.60	44.35	45.77	48.85	21.28	21.0
							AVERAGE	21.14%

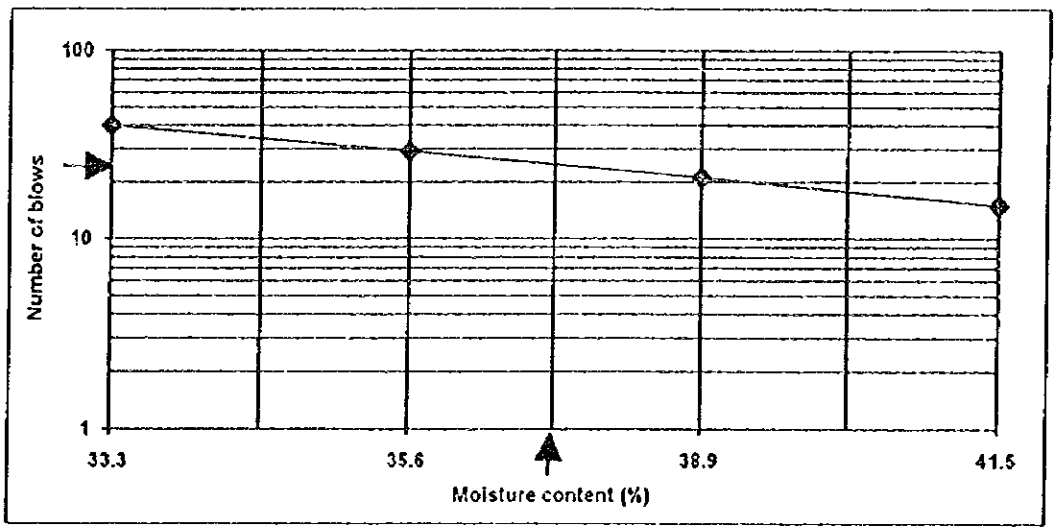
LIQUID LIMIT %	44.60
PLASTIC LIMIT %	21.14
PLASTICITY INDEX %	23.46



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 996	DATE: 2/97

No. OF BLOWS			40	29	21	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			53/71	110	104	108	26	40/47
TIN + WET SOIL	WEIGHT	GMS	45.65	43.35	46.30	50.80	20.05	19.85
TIN + DRY SOIL	WEIGHT	GMS	38.90	36.35	38.20	40.95	19.60	19.35
TIN	WEIGHT	GMS	18.60	16.70	17.40	17.20	16.60	16.30
WATER	WEIGHT	GMS	6.75	7.00	8.10	9,85	0.45	0.50
DRY SOIL	WEIGHT	GMS	20.30	19.65	20.80	23.75	3.00	3.05
MOISTURE CONTENT		%	33.3	35.6	38.9	41.5	15.00	16.39
							AVERAGE	15.70%

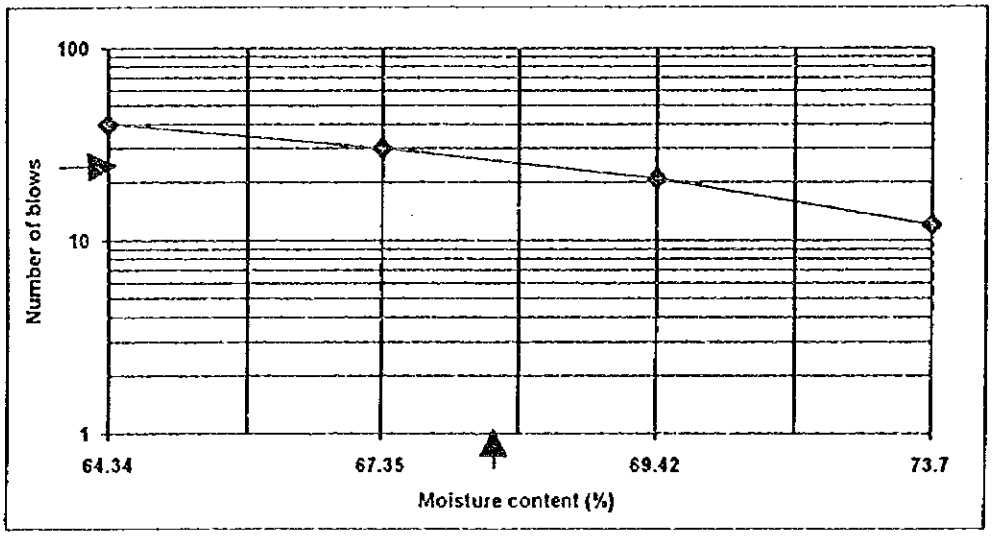
LIQUID LIMIT %	37.10
PLASTIC LIMIT %	15.70
PLASTICITY INDEX %	21.40



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1002	DATE: 6/2/97

No. OF BLOWS			40	30	21	12	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			52	31	53	84	81	77
TIN + WET SOIL	WEIGHT	GMS	41.60	41.50	43.30	45.30	23.50	23.00
TIN + DRY SOIL	WEIGHT	GMS	32.45	31.60	33.20	33.25	21.90	21.70
TIN	WEIGHT	GMS	18.23	16.90	18.65	16.90	16.75	16.99
WATER	WEIGHT	GMS	9.15	9.90	10.10	12.05	1.60	1.30
DRY SOIL	WEIGHT	GMS	14.22	14.70	14.55	16.35	5.15	4.71
MOISTURE CONTENT		%	64.34	67.35	69.42	73.70	31.07	27.60
							AVERAGE	29.33%

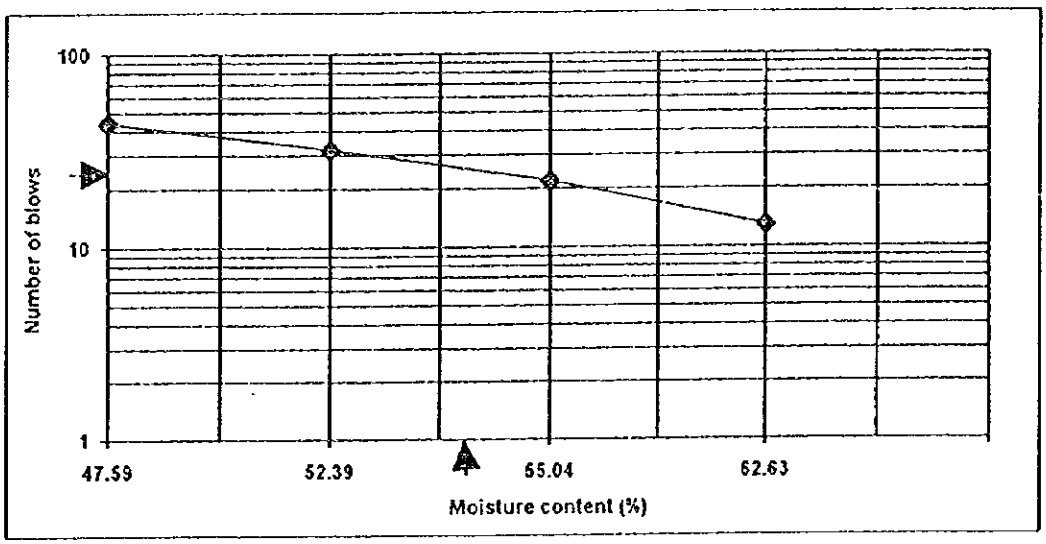
LIQUID LIMIT %	68.00
PLASTIC LIMIT %	29.33
PLASTICITY INDEX %	38.67



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1008	DATE: 6/2/97

No. OF BLOWS			44	32	22	13	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			111	67	22	44	110	55
TIN + WET SOIL	WEIGHT	GMS	41.70	44.20	48.80	50.80	23.35	22.50
TIN + DRY SOIL	WEIGHT	GMS	33.80	34.90	37.60	38.40	21.80	21.40
TIN	WEIGHT	GMS	17.20	17.15	17.25	18.60	16.70	17.20
WATER	WEIGHT	GMS	7.9	9.3	11.2	12.4	1.55	1.10
DRY SOIL	WEIGHT	GMS	16.6	17.75	20.35	19.80	5.10	4.20
MOISTURE CONTENT		%	47.59	52.39	55.04	62.63	30.39	26.19
							AVERAGE	28.29%

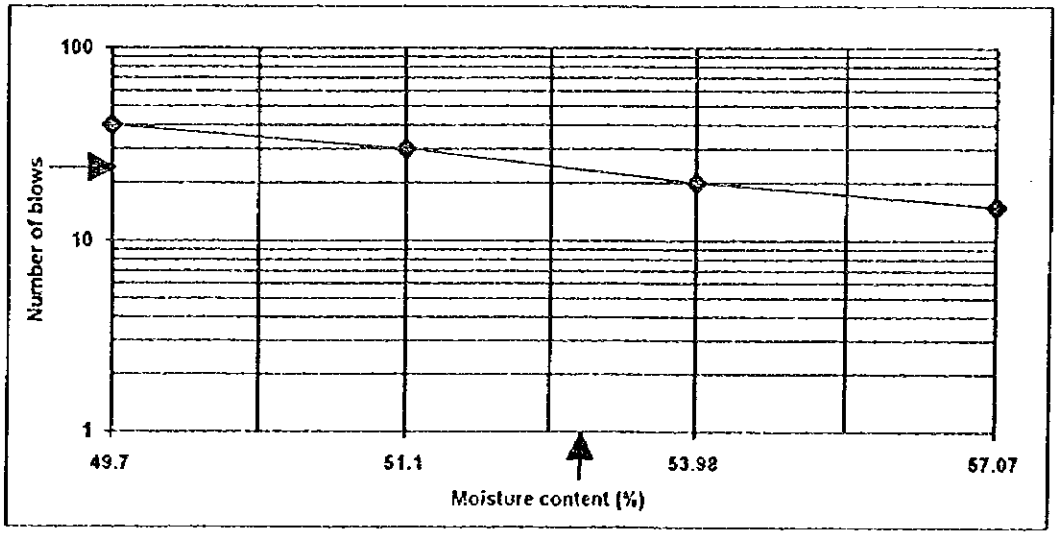
LIQUID LIMIT %	54.40
PLASTIC LIMIT %	28.29
PLASTICITY INDEX %	26.11



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1014	DATE: 2/97

No. OF BLOWS			40	30	20	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			67	47/109	24/17	53/71	44	46/47
TIN + WET SOIL	WEIGHT	GMS	43.85	43.35	44.20	49.60	21.90	21.10
TIN + DRY SOIL	WEIGHT	GMS	35.05	34.40	34.70	38.30	21.05	20.20
TIN	WEIGHT	GMS	17.35	16.90	17.10	18.50	16.90	16.20
WATER	WEIGHT	GMS	8.80	8.95	9.50	11.30	0.85	0.90
DRY SOIL	WEIGHT	GMS	17.70	17.50	17.60	19.80	4.15	4.00
MOISTURE CONTENT		%	49.7	51.1	53.98	57.07	20.48	22.50
							AVERAGE	21.49%

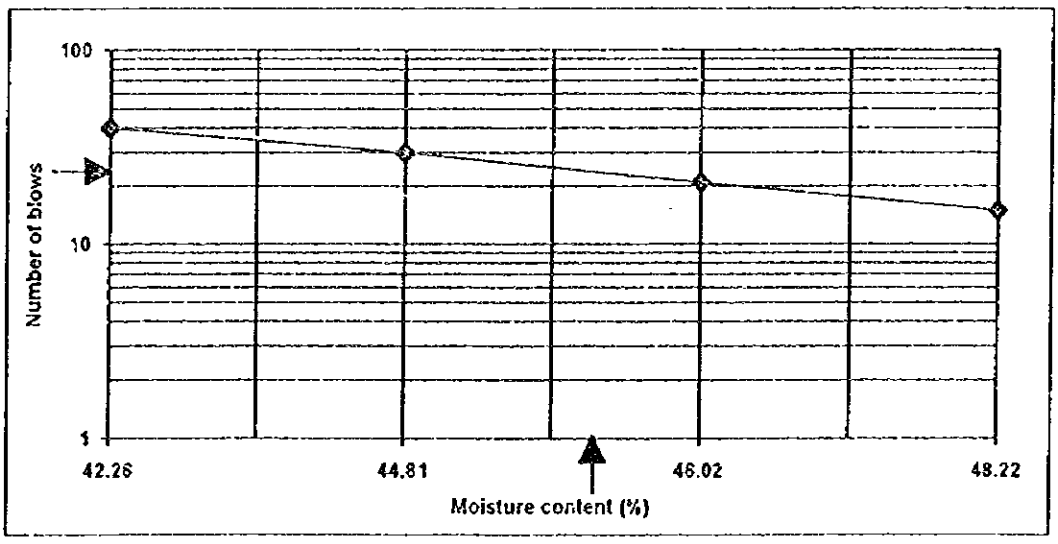
LIQUID LIMIT %	52.90
PLASTIC LIMIT %	21.49
PLASTICITY INDEX %	31.41



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1021	DATE: 2/97

No. OF BLOWS			40	30	21	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			24/107	35/97	34/131	79/36	11	20
TIN + WET SOIL	WEIGHT	GMS	42.80	44.80	42.70	45.95	21.45	20.70
TIN + DRY SOIL	WEIGHT	GMS	35.15	36.60	34.60	37.15	20.75	20.15
TIN	WEIGHT	GMS	17.05	18.30	17.00	18.90	16.50	16.55
WATER	WEIGHT	GMS	7.65	8.20	8.10	8.80	0.70	0.55
DRY SOIL	WEIGHT	GMS	18.10	18.30	17.60	18.25	4.25	3.60
MOISTURE CONTENT		%	42.26	44.81	46.02	48.22	16.47	15.28
							AVERAGE	15.87%

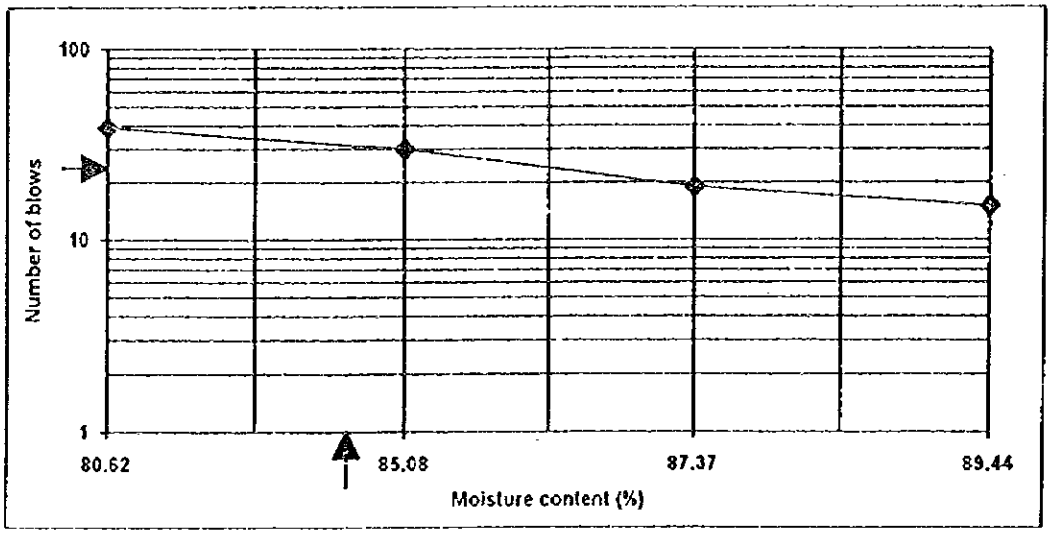
LIQUID LIMIT %	45.20
PLASTIC LIMIT %	15.87
PLASTICITY INDEX %	29.33



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1028	DATE: 2/97

No. OF BLOWS			39	30	19	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			67	52/55	79/36	45/78	20	!1
TIN + WET SOIL	WEIGHT	GMS	43.50	49.95	46.35	45.80	20.70	20.30
TIN + DRY SOIL	WEIGHT	GMS	31.85	35.40	33.55	32.25	19.90	19.55
TIN	WEIGHT	GMS	17.40	18.30	18.90	17.10	16.60	16.55
WATER	WEIGHT	GMS	11.65	14.55	12.80	13.55	0.80	0.75
DRY SOIL	WEIGHT	GMS	14.45	17.10	14.65	15.15	3.30	3.00
MOISTURE CONTENT		%	80.62	85.08	87.37	89.44	24.24	25.00
							AVERAGE	24.62%

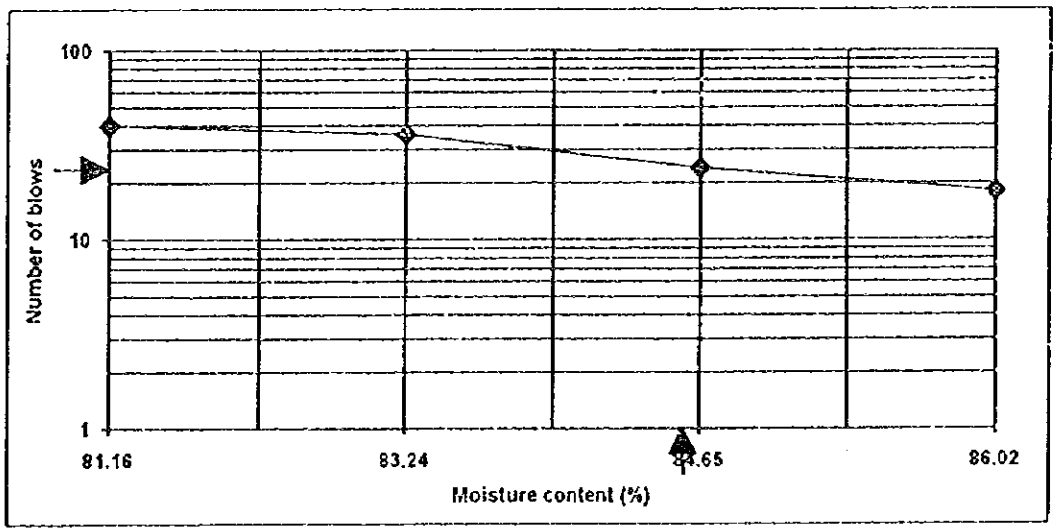
LIQUID LIMIT %	84.90
PLASTIC LIMIT %	24.62
PLASTICITY INDEX %	60.28



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1032	DATE: 13/2/97

No. OF BLOWS			40	36	24	18	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			41	202	113	207	40	26
TIN + WET SOIL	WEIGHT	GMS	44.40	50.90	54.30	59.20	21.50	22.20
TIN + DRY SOIL	WEIGHT	GMS	31.90	35.50	37.20	39.50	20.00	20.50
TIN	WEIGHT	GMS	16.50	17.00	17.00	16.60	16.00	16.40
WATER	WEIGHT	GMS	12.50	15.40	17.10	19.70	1.50	1.70
DRY SOIL	WEIGHT	GMS	15.40	18.50	20.20	22.90	4.00	4.10
MOISTURE CONTENT		%	81.16	83.24	84.65	86.02	37.50	41.46
							AVERAGE	39.48%

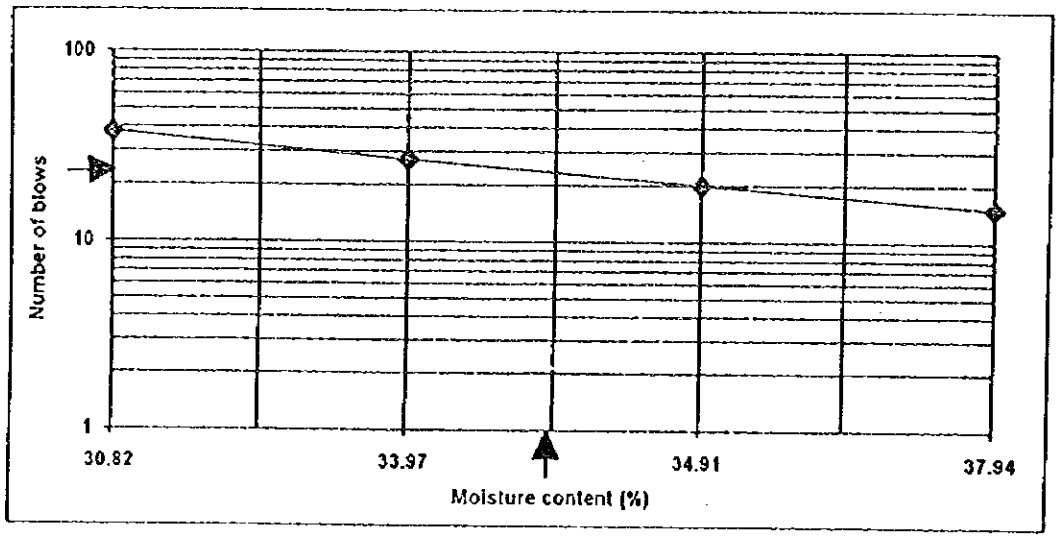
LIQUID LIMIT %	84.50
PLASTIC LIMIT %	39.48
PLASTICITY INDEX %	45.02



PROJECT: KUNDUCHI PROPOSED DUMP SITE	
DESCRIPTION: Kunduchi New MECCO Quarry	
LAB. No. 1033	DATE: 2/97

No. OF BLOWS			38	27	20	15	PLASTIC LIMIT	
MOISTURE CONTENT TIN No.			108	204/65	110	18	22	28
TIN + WET SOIL	WEIGHT	GMS	44.15	41.35	46.45	50.15	21.50	21.00
TIN + DRY SOIL	WEIGHT	GMS	37.80	35.10	38.70	41.50	20.70	20.30
TIN	WEIGHT	GMS	17.20	16.70	16.50	18.70	16.40	16.45
WATER	WEIGHT	GMS	6.35	6.25	7.75	8.65	0.80	0.70
DRY SOIL	WEIGHT	GMS	20.60	18.40	22.20	22.80	4.30	3.85
MOISTURE CONTENT		%	30.82	33.97	34.91	37.94	18.60	18.18
							AVERAGE	18.39%

LIQUID LIMIT %	34.00
PLASTIC LIMIT %	18.39
PLASTICITY INDEX %	15.61



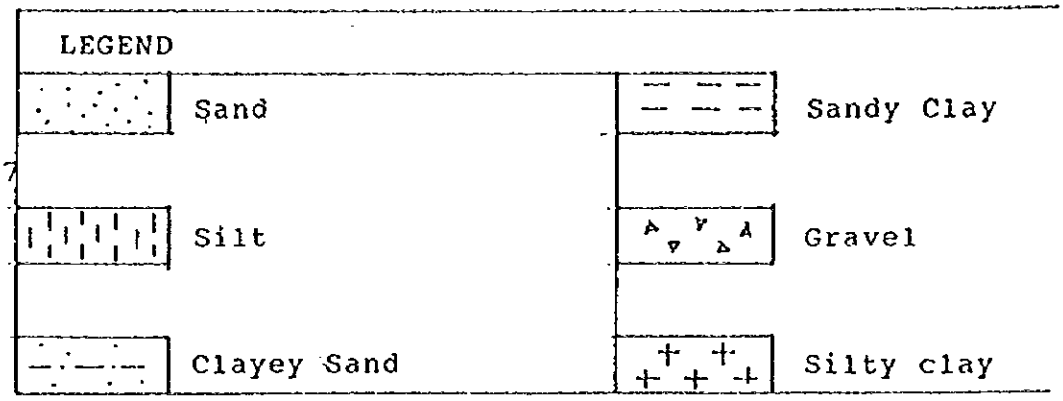
APPENDIX 2

Borehole Log Diagrams

TP No 1

KINZUDI
BORROW AREA

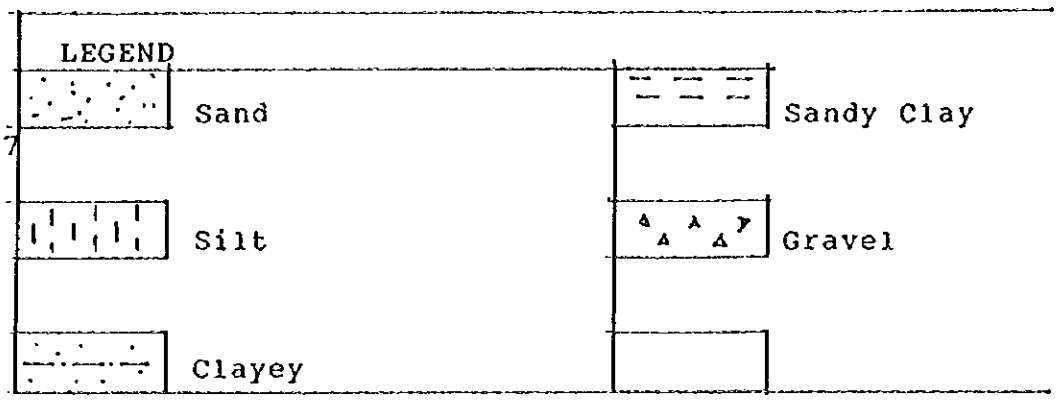
DATE: 19/2/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Reddish Brown clayey silty SAND of slight plasticity
1.00		Light grey with red patches silty clayey SAND of low to medium plasticity
1.75		Yellowish grey with red patches silty clayey gravelly SAND of medium to high plasticity
2.25		Yellowish brown silty clayey SAND of medium plasticity
3.00		Yellowish grey clayey silty SAND of medium plasticity
4.00		

P No 2
KINZUDI
ORROW AREA

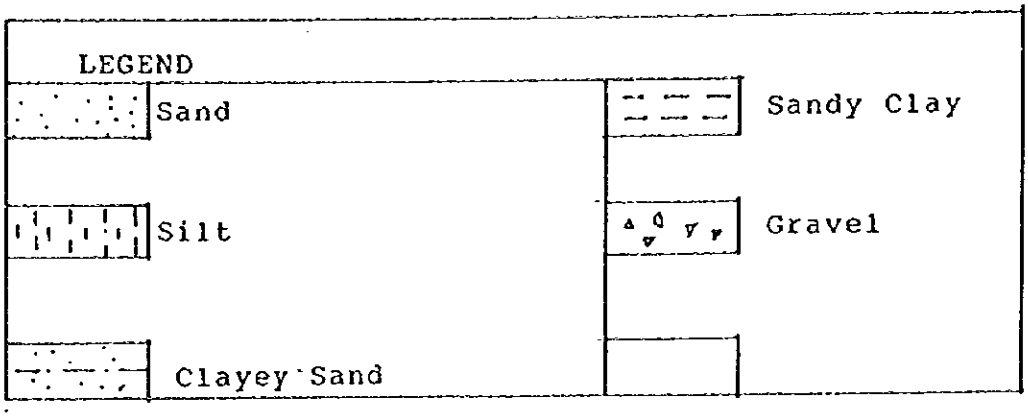
ATE: 19/2/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Top soil, light black silty SAND
0.25		Reddish brown silty clayey SAND of low to medium plasticity
1.00		Grey with red patches clayey sity SAND of medium plasticity
1.25		

B/H No 1
KUNDUCHI
PROPOSED
LANDFILL SITE

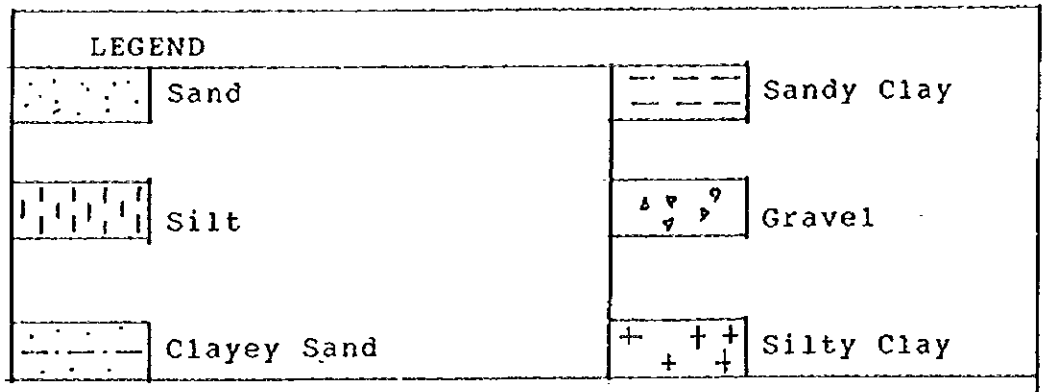
DATE: 22/1/1997
to 27/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Yellowish silty clayey SAND of high plasticity
1.25		Greyish sandy SILTY CLAY of high plasticity
3.46		Greyish yellow sandy clayey silt of low to medium plasticity
6.64		Grey sandy silty clay of medium to high plasticity
7.16		Yellowish clayey silty SAND slightly plastic
12.50		Whitish yellow silty SAND of non plastic
14.70		Yellowish grey silty sandy clay of medium plasticity
15.04		

B/H No 2
KUNDUCHI
PROPOSED
LANDFILL SITE

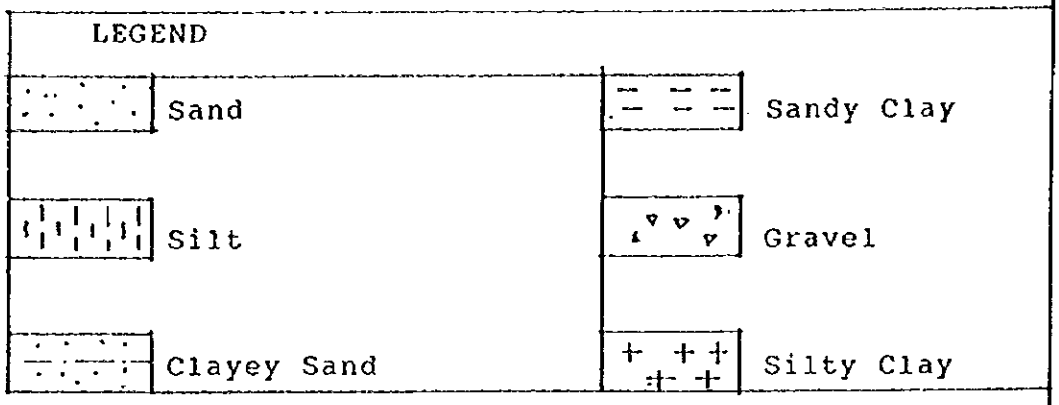
DATE: 24/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Yellow clayey silty SAND of slight to low plasticity
1.90		Yellow silty SAND of non plasticity
3.00		Yellow clayey silty SAND of medium plasticity
3.51		SANDSTONE (ROCK)

B/H No 3
KUNDUCHI
PROPOSED
LANDFILL SITE

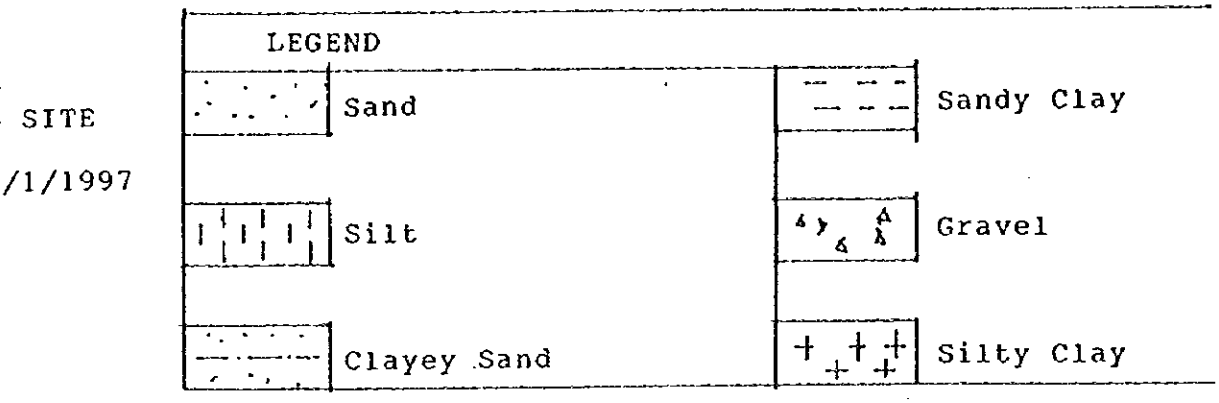
DATE: 25/1/1997
to 30/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		
		Red deposited material, sandy silty CLAY of high plasticity
0.45		
		Whitish grey silty SAND of low plasticity
3.10		
		Grey sandy silty CLAY of medium to high plasticity
4.83		
		Grey/Yellow with purple patches silty CLAY of high plasticity
6.08		
		Grey with patches of yellow clayey silty SAND of low to medium plasticity
8.26		
		Light grey with yellow patches silty SAND of low plasticity
9.44		
		Grey with Yellow sandy ,silty CLAY of medium plasticity
10.94		
		Grey clayey silty SAND of low to medium plasticity
11.45		
		Yellowish brown/Whitish grey silty sandy CLAY of high plasticity
13.00		
		Whitish/ Pinkish Grey clayey silty SAND of low to medium plasticity
15.00		

B/H No 4
KUNDUCHI
PROPOSED
LANDFILL SITE

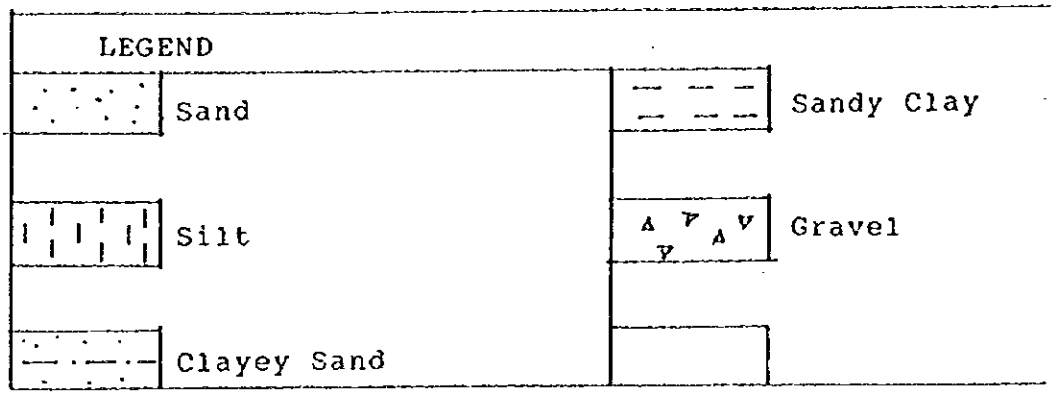
DATE: 27/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		
0.25		Whitish grey/ light brown clayey silty SAND of low plasticity
1.88		Brownish grey with sandstone clayey silty SAND of low plasticity
2.75		Greyish white SAND of non plasticity
2.95		White Limestone rock

B/H No 5
PROPOSED
LANDFILL SITE

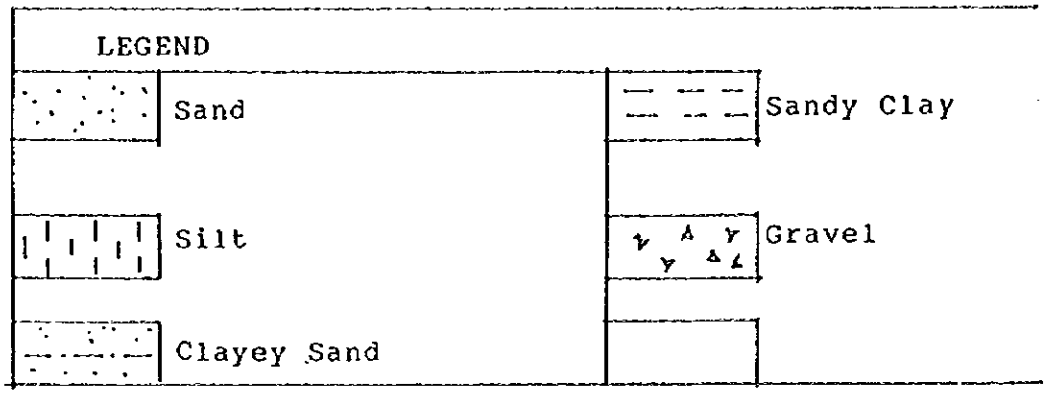
DATE: 28/1/1997
to 29/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Reddish brown silty sandy CLAY of high plasticity
0.30		SANDSTONE MATERIAL
0.40		Yellowish clayey silty SAND of low to medium plasticity
0.90		Light yellow silty SAND of non plasticity
2.58		Yellowish grey clayey silty SAND of low to medium plasticity
2.77		Yellow silty SAND of non to light plasticity
6.44		SANDSTONE

B/H No 6
KUNDUCHI
PROPOSED
LANDFILL SITE

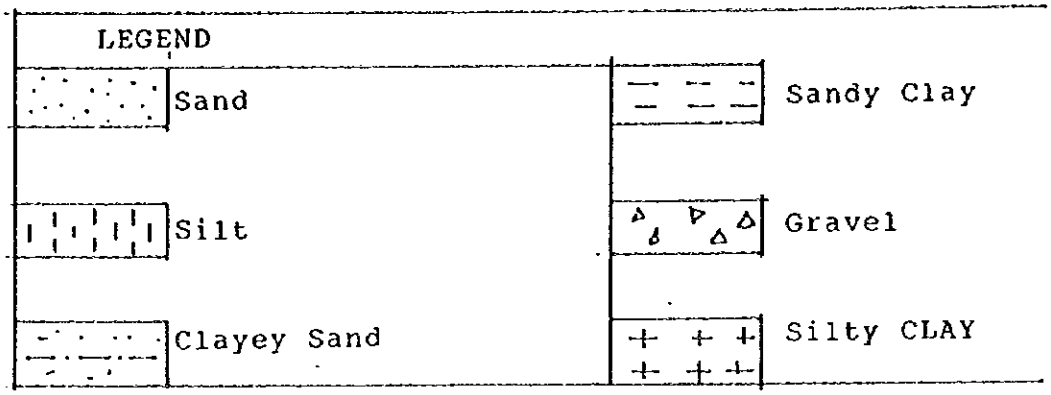
DATE: 29/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Grey with light brown and Yellow Limestone with silty sandy CLAY of medium plasticity
0.20		Light Yellow silty SAND of non plasticity
0.65		Yellow silty SAND of non plasticity with broken stone
1.15		SAND STONE
1.25		

B/H No 7
KUNDUCHI
PROPOSED
LANDFILL

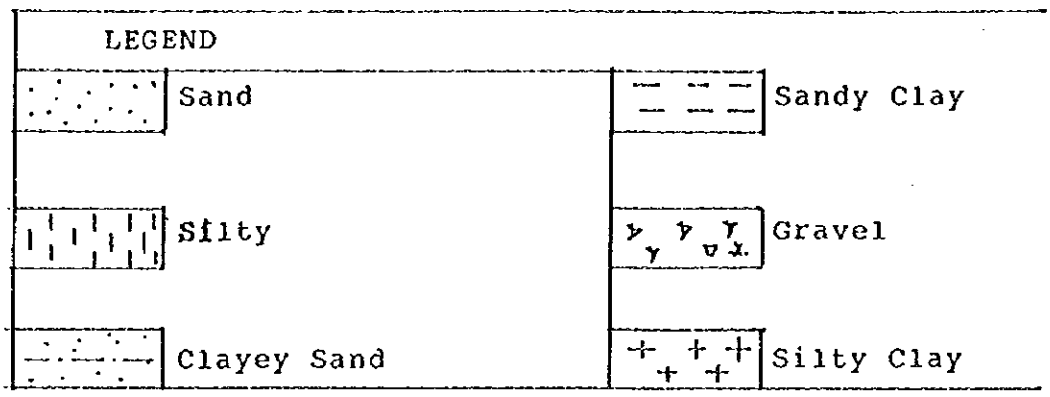
DATE: 29/1/1997
to 31/1/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Grey with Yellow patches silty sandy CLAY of high plasticity with broken stone patches
0.40		
0.50		SANDSTONE
0.88		Yellowish silty fine SAND of non plasticity
1.16		SANDSTONE
1.55		Light Yellow silty SAND of non plasticity
2.90		Yellow silty SAND of non plasticity with sandstone gravels
3.06		Yellowish brown sandy silty CLAY of high pla.
4.47		Light Yellow silty SAND of non plasticity with sand stone gravels
4.78		Dark brown silty CLAY of high plasticity
5.57		Grey with Yellow sandy clayey SILT of slight plasticity
		SANDSTONE

B/H No 8
KUNDUCHI
PROPOSED
LANDFILL

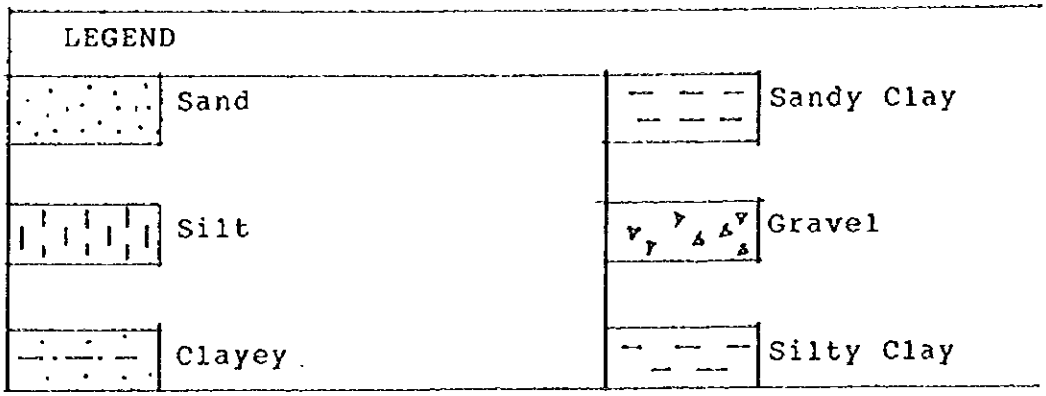
DATE: 31/1/1997
to 1/2/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Grey silty sandy CLAY of medium to high plasticity
0.40		Yellowish Grey clayey silty SAND of low to medium plasticity
1.50		Light grey/Grey clayey silty SAND of low to medium plasticity
6.20		

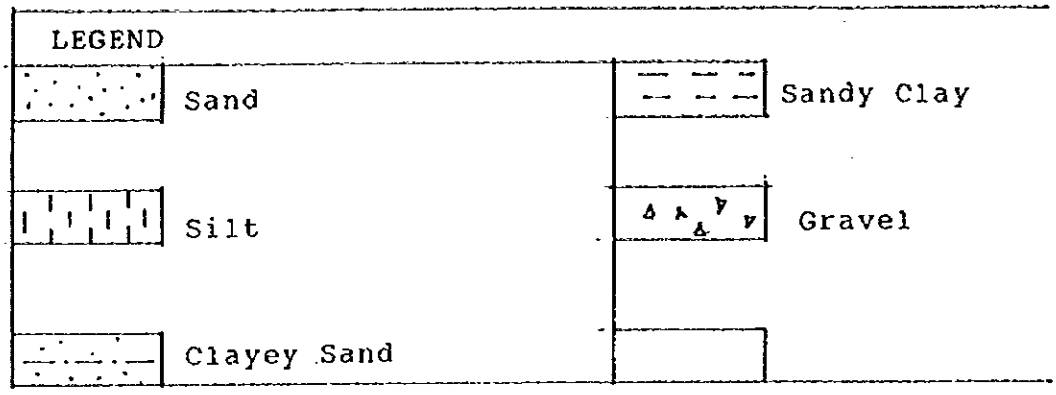
B/H No 10
KUNDUCHI
PROPOSED
LANDFILL SITE

DATE: 30/1/1997
to 4/1/1997



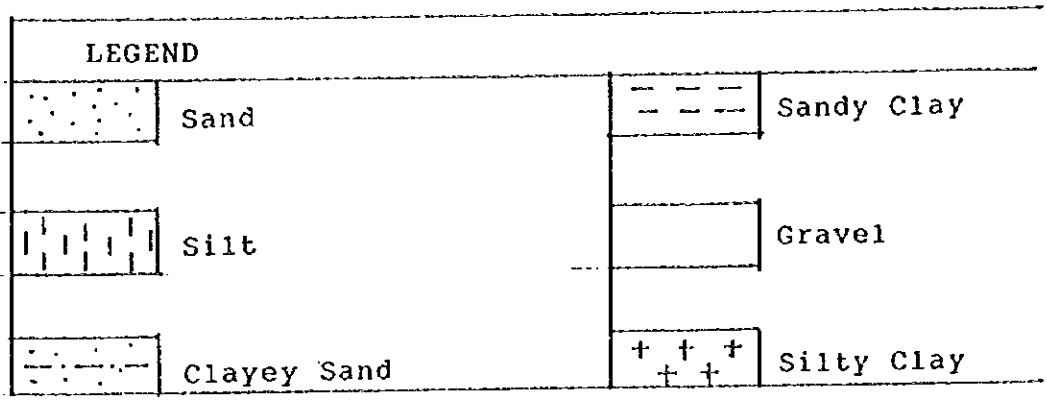
DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		Red silty sandy CLAY of medium to high plasticity
0.30		Yellowish Grey silty sandy CLAY of high plasticity
2.00		Reddish brown with grey sandy silty CLAY of medium plasticity (with lime patches)
2.75		Greyish Yellow sandy silty CLAY of medium to high plasticity
3.65		Yellowish clayey silty SAND of low plasticity
6.60		Grey with yellow patches sandy silty CLAY of medium plasticity
7.40		Grey clayey silty SAND of low plasticity
9.18		Light grey/ Yellow silty SAND of non plasticity
13.75		Silty clayey SAND of low to medium plasticity
14.07		Yellowish grey silty SAND of non plasticity
15.10		At 7.40 - 7.45 m there is SANDSTONE

B/H No 11
KUNDUCHI
PROPOSED
LANDFILL SITE
(IN WESTERN VALLEY)
DATE: 3/2/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		
		Dark Grey silty SAND of non plasticity
1.10		
		Grey with yellow patches silty clayey SAND of medium plasticity
2.80		
		Greyish Yellow silty sandy CLAY of high plasticity
3.70		
		Brownish silty clayey SAND of high plasticity
4.00		

B/H No 12
KUNDUCHI
PROPOSED
LANDFILL SITE
(IN WESTERN VALLEY)
DATE: 3/2/1997
to 4/2/1997

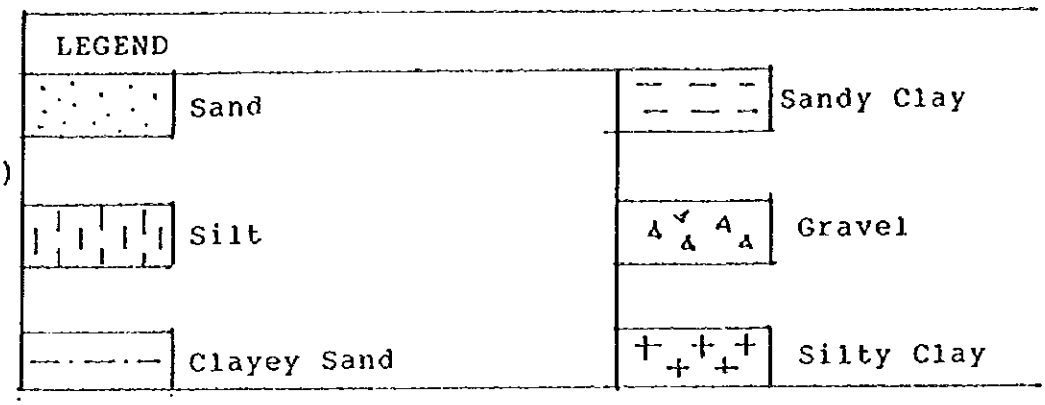


DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		
		Dark Grey clayey silty SAND of low plasticity
1.18		
		Dark Grey silty SAND of non plasticity
1.66		
		Grey with yellow patches silty clayey SAND of medium plasticity
2.86		
		Brownish yellow silty sandy CLAY of high plasticity
4.25		
		Whitish sandy SILT (Lime) of medium plasticity
5.01		
		Grey with some lime stone SILT of medium plasticity
5.50		

B/H No 13
KUNDUCHI
PROPOSED
LANDFILL SITE

(AT SALT MINES)

DATE: 5/2/1997
to 7/2/1997



DEPTH M	LITHOLOGY	SOIL DESCRIPTION
0.00		
		Dark Grey /gey with yellow silty SAND of non plasticity
0.85		
		Brownish Yellow siltyclayey SAND of medium plasticity
1.40		
		Dark grey clayey silty SAND of high plasticity
2.40		
		Dark grey clayey silty SAND of slight plasticity
3.50		
		Grey clayey silty SAND of low plasticity
7.45		
		Grey silty clayey SAND of medium to high plasticity
9.15		

APPENDIX 3

Some Meteorological Data for Dar es salaam International Airport, Wazo hill, and Tanganyika Pakers Weather Stations

Dar es Salaam International Airport

Mean monthly Wind Speed (knots)

0600 UTC

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	3	5	3	3	7	8	7	5	5	5	5	4
1982	6	6	6	2	8	8	5	5	4	5	3	6
1983	7	7	3	6	6	6	6	5	3	3	5	8
1984	9	10	3	5	5	8	4	2	3	4	3	5
1985	7	5	3	4	6	6	6	5	5	4	4	5
1986	7	7	3	5	5	6	7	4	5	5	5	6
1987	9	9	5	5	7	7	6	5	5	4	6	7
1988	6	5	5	5	6	4	3	4	3	4	5	5
1989	7	9	5	5	4	9	9	7	8	7	7	9
1990	9	7	6	6	9	6	6	5	7	6	7	7

1200 UTC

1981	6	6	5	6	8	9	10	10	10	9	9	6
1982	7	8	9	4	9	10	8	8	9	9	7	9
1983	10	10	7	6	7	7	10	9	8	11	12	10
1984	12	12	9	6	9	10	6	6	10	9	7	8
1985	8	8	7	7	7	9	8	9	9	9	8	8
1986	9	10	5	5	5	8	9	9	9	10	8	9
1987	11	11	7	6	8	9	8	9	9	9	11	10
1988	8	10	8	6	8	8	7	10	8	10	10	8
1989	9	11	7	6	6	10	13	12	13	13	11	11
1990	11	11	8	6	11	10	10	11	13	12	11	9

DAR ES SALAAM INTERNATIONAL AIR PORT

YEAR	CODE	JAN.	FEB.	MARCH	APR	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC
1989	202	23.296	23.75	22.961	22.416	21.28	18.993	18.319	18.154	18.693	19.651	20.886	23.729
	214	156.0	186.5	180.3	170.5	120.5	129.1	159.9	164.2	176.7	186.1	201.9	206.1
1990	201	31.722	32.939	31.458	30.986	30.367	29.44	28.838	29.203	30.033	31.112	31.216	31.11
	202	22.854	23.61	22.635	22.66	21.29	18.906	17.471	17.854	18.723	19.861	22.246	23.025
	214	276.3	167.1	176.3	182.9	168.3	180.2	192.9	177.3	162.7	182.1	171.2	170.9
1991	201	32.483	31.889	32.232	32.383	29.225	29.62	28.99	28.88	30.016	31.383	31.26	30.5
	202	23.754	24.203	22.88	22.22	21.803	19.063	18.696	18.19	18.356	20.229	21.856	23.032
	214	192.5	209.2	205.0	173.8	136.4	126.6	158.4	152.5	163	178.2	156.2	123.2
1992	201	31.638	32.017	32.177	30.133	29.925	29.24	28.606	29.396	30.68	31.322	30.903	30.687
	202	24.277	23.365	23.238	22.92	21.625	20.226	18.348	17.367	18.123	19.329	21.846	22.635
	214	200.0	173.4	163.8	135.8	139.2	112.2	126.3	151.1	162.0	191.6	120.6	135.6
1993	201	31.067	31.939	31.454	30.066	30.18	29.293	28.748	28.983	30.083	30.312	31.456	31.945
	202	23.712	23.657	22.848	22.59	22.051	19.2	17.561	17.883	18.146	19.593	21.52	22.841
	214	161.6	189.3	161.8	103.6	150.3	137.4	144.5	132	142.8	147.5	183	196.4

Source: Directorate of Meteorology DSM - 1997

ST: WAZO HILL 09639040

MONTHLY RAINFALL TOTALS (mm)

M - MISSING VALUE

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1983	40.7	48.6	21.2	172.9	244.2	19.2	9	6.3	9.8	139.3	10.7	93.9
1984	22.5	0	74.4	322.1	105.7	66.7	30.7	7.1	0.7	28.2	84.9	166.6
1985	92.7	166.4	94.3	158.9	90.9	0	29.6	0.9	6	34.6	30.5	108.8
1986	26.4	0	67.8	295.1	208.7	5.9	1.2	21.5	55.3	84.4	99.7	140.4
1987	54	9	102	187.7	280.8	0	11.3	34.4	0	20.9	12.4	28.9
1988	132.8	3.2	109.9	150.1	27.8	48.6	0	24.8	27.8	30.5	56.4	87.2
1989	232.2	0	25.6	M	181.2	24.5	0	0	11.5	37.5	39.4	80.9
1990	46.7	107.2	137.9	216.0	64.8	0	0	9.6	3.2	5.8	190.7	51.3
1991	72.8	4.8	88.8	5.60	191.2	3.2	4.9	29.5	8.8	9.4	104.1	142.3
1992	7.2	20.9	194	262.7	121.1	0	9.3	20.6	4.8	31.4	73.1	39.2
1993	78.2	20.4	194.0	262.7	121.1	0.0	9.3	20.6	4.8	31.4	73.1	39.2
1994	10.9	99.7	130.2	340	127.6	0	16.0	0	6.6	94	87.3	M

Source: Directorate of Meteorology DSM - 1997

DAR ES SALAAM INTERNATIONAL AIR PORT

201 - Mean monthly maximum temperature (C^{o})

201 - Mean monthly minimum temperature (C^{o})

214 - Monthly evaporation (mm)

M - Missing value

YEAR	CODE	JAN.	FEB.	MARCH	APR	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC
1983	201	32.038	32.617	M	31.279	30.056	29.91	29.751	29.396	30.643	31.229	31.706	32.354
	202	23.183	23.557	22.871	22.896	22.054	19.763	18.579	18.132	17.73	18.722	20.613	22.925
	214												
1984	201	31.251	32.44	32.606	M	29.351	28.38	28.035	28.316	30.113	30.55	30.693	31.083
	202	13.409	23.228	21.954	22.35	20.926	19.243	18.166	16.948	17.246	19.841	21.596	23.116
	214												
1985	201	31.677	30.914	31.777	30.78	29.854	29.34	28.548	29.806	30.786	31.096	31.466	32.009
	202	23.319	23.003	21.938	21.83	20.958	18.29	18.171	17.69	17.646	19.351	21.073	22.84
	214	M	M	M	M	188.8	124.9	134.2	M	204.9	213.7	M	M
1986	201	32.0	33.771	31.922	30.12	29.783	29.072	29.2	29.845	30.926	31.461	31.383	32.306
	202	23.08	23.117	22.006	22.193	21.219	18.927	17.058	17.193	17.933	20.287	21.933	23.236
	214	161.2	233.5	185.8	M	157.2	128.2	146.0	157.1	162.3	156.4	182.3	177.1
1987	201	32.68	32.91	33.606	32.503	30.538	29.9	29.583	29.662	30.99	31.406	32.633	32.325
	202	24.196	23.635	23.038	22.43	21.861	18.74	18.24	19.412	18.596	20.351	21.383	23.535
	214	210.7	206.8	201.7	161.4	135.7	147.8	146.5	147.2	156.8	167.7	196.1	205.2
1988	201	32.48	33.217	33.145	31.53	31.383	29.526	29.812	30.235	30.146	31.551	31.69	31.203
	202	24.261	23.282	23.616	22.603	21.006	20.456	19.022	19.325	19.54	20.116	21.726	22.443
	214	240.8	207.8	181.9	154.6	159.8	124.6	162.8	135.0	135.8	184.4	202.1	153.6
	201	29.687	31.782	31.04	29.67	28.367	28.436	28.774	28.154	29.53	30.064	31.163	31.541

ST: DAR ES SALAAM INTERNATIONAL AIRPORT 09639029

MONTHLY RAINFALL TOTALS (mm)

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1983	37.2	61.9	78	224	405.6	39.4	45.9	13.9	6.8	70	15.8	67.2
1984	116.4	0	128.4	441.2	184.2	60.1	28.4	5.1	6.5	104.4	111.1	182.3
1985	93.8	124.1	114.8	135	184	2.4	62.1	12.8	1.4	33.8	61.7	122.9
1986	35.8	0.4	210.8	398.4	293.5	13.3	1.7	34.6	46	109	242.7	46.2
1987	21.1	13.9	77.9	160.9	246.5	0.8	16.4	73.6	2.8	40.7	48.1	22.2
1988	183.3	13.2	105.2	245.7	15.3	78.5	9.3	48.2	32.7	8.8	62.4	152.7
1989	268.2	0	105.3	259.3	196.5	34.6	5.7	33.7	22.8	72.3	28	175.6
1990	110.2	160.9	93.5	271.5	100.3	29.2	29.9	7.3	23.6	29.6	230.2	55.6
1991	92.9	17.3	75.2	17.4	353	4.6	28.9	21.7	13	25.7	218.6	187.4
1992	9.2	114.6	51.3	325.4	288.1	37.2	34.8	3.1	20.9	2.6	138.3	120
1993	71.3	34.8	118.2	322.6	199.4	17.4	14.1	10.1	9.1	109.9	161.5	86.9
1994	138.68	254.25	253.23	734.56	434.59	11.176	127.25	25.4	23.622	175	*	*

Source: Directorate of Meteorology DSM - 1997

ST: TANGANYIKA PACKERS (KAWE) 09639026

MONTHLY RAINFALL TOTALS (mm)

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1983	3.3	34.8	86.6	144.8	208.0	73.7	0	8.9	2.5	89.7	4.4	109.3
1984	8.8	0	85.2	416.1	66.9	24.0	0	0	0	0	18	0
1985	0	M	98	165.1	131.4	0	58.9	19.5	2.8	43.8	39.5	116
1986	21.1	12	115.9	345.1	203.7	0	0	3	36	37.5	80	76.8
1987	0	16.8	51.5	229	269.5	0	21	54.5	0	3.5	12.7	16.8
1988	130.8	0	100.5	111.7	56	71.3	0	10.9	0	0	0	182
1989	215	0	0	230.8	395.5	59	40.5	65	0	0	40	144.5
1990	61.9	78	108.5	294.5	85	0	0	21	8	0	224	78
1991	41.5	12	87.5	29.5	301.3	0	0	38	0	32.3	109	90.5
1992	0	20.0	M	M	M	M	M	M	M	M	M	M
1993	M	M	M	M	M	M	M	M	M	M	M	M
1994	0	12.4	116.8	373.8	94.0	10.2	52.3	5.1	0	84.8	293.2	64.5

Source: Directorate of Meteorology DSM - 1997

APPENDIX 4

Technical Specifications for the measurement, data collection and environmental impact assessment works

Technical Specifications for the measurement, data collection and environmental impact assessment works

1. General

This specification applies to the Environmental Impact Assessment (EIA) to be conducted for the Kunduchi New MECCO quarry site as the proposed disposal site, hereafter referred to as the 'disposal site', for the Study on the Solid Waste Management for Dar es Salaam City in the United Republic of Tanzania.

The purposes of this works are as follows.

- to measure and collect data required for designing the final disposal site
- to measure and collect data required for the environmental impact assessment

1.1 Scope of Work

The scope of work shall include all works such as transporting and setting up equipment, sampling and measurement, recording and analysis of samples and data and compiling a report.

1.2 Contractor's Obligation

The Contractor shall follow "Environmental Guidelines for Infrastructure Projects; Chp. VI Solid Waste Management"; JICA, Sept. 1992.

The Contractor shall follow the instructions given by the Engineer below regarding the EIA content, method, measurement and analysis. In particular, the Contractor is referred to the Initial Environmental Examination conducted by the Engineer for the disposal site, which shall be used as a guide for conduction of the EIA.

All required items and resources for these works, such as equipment, instruments, vehicles, etc., except the items specified in Section 1.4, shall be borne by the Contractor.

1.3 Work Schedule and Time of Completion

The measurement works will begin in the 1st week of January 1997 and shall be completed in the middle of March 1997. The reports shall be submitted with 3.5" floppy diskettes containing all data and the reports. Software to be used for these reports is Microsoft Word and Excel.

1.4 Items to be lent or supplied by the Engineer

The items to be lent by the Engineer to the Contractor include:

- a number of noise and vibration meters.
- The Contractor shall return them to the Engineer in good condition immediately on completion of the measurement works.

The items to be supplied by the Engineer to the Contractor include:

- gas detector tubes for measuring NH_3, SO_2, NO_x and CO;
- Japanese standard for traffic, noise and vibration survey measurements (if necessary);
- Japanese standard for air quality measurements (if necessary).

1.5. Study Area

The study area covers the Kunduchi New MECCO quarry site, its environs and the New Bagamoyo road from the Kunduchi New MECCO quarry site to the intersection with Sam Nujoma Road.

2. Measurement and Data Collection Works

2.1 Topographical Survey

The contents of the survey works will be as follows;

Area: Topographical survey and mapping work shall cover the whole area of the Kunduchi New MECCO Quarry site and its environs specified by the Engineer. The area to be surveyed is 50 hectares.

Scale: 1 to 2000

Contour Interval: 1.0 m

All measurements shall be indicated in metric units.

One Temporary Bench Mark (T.B.M.) shall be set up at each site and the National Temporary Bench Mark shall be tied to the existing Bench Mark which has been established by the Governmental authority.

Temporary Bench Marks shall be set up at stable and safe places.

The elevation of the ground level and TBM shall be determined by levelling, starting from the existing Bench Marks.

The accuracy of levelling shall be 2 cm S, where S is levelling length in kilometres.

Three copies of the topographical map shall be submitted to the Engineer.

If the map is drawn in digital form, the digital data also shall be submitted to the Engineer.

The topographical map shall indicate:

- the locations of Temporary Bench Marks;
- the existing terrain, facilities such as houses, roads, drainage, riverbanks, electricity poles, wells, water supply pipes, telephone poles and others, if any.

2.2 Geological Survey

The Geological survey is divided into two parts: investigation of geological features and investigation of borrow soil.

2.2.1 Investigation Survey of Geological Features

1) Boring work

a) Number of Boreholes: variable

b) Depth of the boreholes: total depth of 90 metres

Final depths and exact boring locations of the boreholes shall be confirmed by the Engineer at the site.

2) Preparation of borehole diagrams

The borehole log diagrams including engineer's descriptions shall be prepared.

The soil structure layer diagram shall be prepared based on the borehole log diagrams.

3) Soil Sampling

A total of 18 soil samples will be taken from the drilled boreholes according to the Engineer's instructions.

4) Water table

The groundwater table shall be measured and recorded for each borehole.

5) Laboratory Test

The following tests shall be conducted for each sample:

a) Unit weight test of soil
b) Density test of soil particles
c) Water content test of soil
d) Mechanical analysis of soil, including sieve analysis and wet mechanical analysis
e) Atterberg limit (Liquid and plastic limit test)
f) Permeability test

2.2.2 Test of borrow soil

1) Sampling

The Contractor shall look for proper borrow sites of clay soil with the Engineer jointly. Six samples of soil shall be taken at the sites directed by the Engineer. The available volume of clay soil shall be measured roughly.

2) Laboratory test

The following tests shall be conducted for six samples.

a) Unit weight test of soil
b) Density test of soil particles
c) Water content test of soil
d) Mechanical analysis of soil, including sieve analysis and wet mechanical analysis
e) Atterberg limit (Liquid and plastic limit test)
f) Soil compaction test

2.2.3 Reporting

The final report shall include the followings:

1) Location Map
2) Work Method
   - Boring
   - Sampling

- Laboratory tests

3) Work Results

- Borehole log
- Summary of the work
- Results of the laboratory tests
- Summary of the laboratory tests

4) Photographs

- Field works
- Split soil sample
- Laboratory tests

2.3 Water Quality Survey

1) Sampling Points

- 2 points for stream
- 5 points for groundwater

The exact sampling points shall be instructed by the Engineer at site.

2) Analysis Items

Colour, turbidity, pH, dry matter, electrical conductivity, DO, COD, BOD, SS, coliform bacteria, T-N, NH_4^+, Na^+, Ca^{2+}, Fe, Cl^-, SO_4^{2-}, Cr^{6+}, Cd, Pb, As

3) Frequency of sampling

three times per sampling point

4) Sampling Time

After three days of fine weather in principle.

5) Analysis Method

Analysis method shall be either the method stipulated in Tanzanian standard, common method in Tanzania or WHO standard.

6) Others

The following items shall be measured and recorded at the time of sampling;

- Air temperature
- Water Temperature
- Weather

2.4 Soil Contamination Analysis

1) Sampling points

- One point at the Kunduchi New MECCO Quarry site
- One point at the Kunduchi Old MECCO Quarry site

The exact sampling points shall be instructed by the Engineer at the site.

2) Analysis items

Cd, Pb, all Cr, Cr^{6+}, CN^-, Cu, Zn, Fe, Mn

3) Method and frequency of survey

Elution analysis shall be conducted on every survey item.

One sample shall be taken at each sampling point.

4) Method of analysis

Analysis method shall be, in principle, either the method stipulated in Tanzanian standards, common method in Tanzania or WHO standard.

2.5 Traffic Volume Survey

1) Items to be measured

- Condition of road, including number of lanes, width of road, type of pavement, etc.
- The categories of vehicles which shall be measured separately are large vehicles, small vehicles and motorcycles.

2) Frequency of survey

Number of vehicles which pass the road shall be measured and recorded hourly from 6 am until 7 pm for three days at two points.

3) Survey points

A1: on Bagamoyo Road, 100-200 m north of the intersection with Sam Nujoma Road

A2: on Bagamoyo Road, near to the disposal site on the south side

2.6 Noise Survey

1) Items to be measured

Noise level of L_{95}, L_{50} and L_5

2) Frequency of survey

Noise levels shall be measured and recorded every five seconds for ten minutes hourly from 6 am until 7 pm for three days at the two points indicated with a noise level meter. Noise levels corresponding to L_{95}, L_{50} and L_5 shall be calculated from this data. The results shall be presented in an appropriate tabular/graphic form.

3) Survey points

A1: on Bagamoyo Road, 100-200 m north of the intersection with Sam Nujoma Road

A2: on Bagamoyo Road, near to the disposal site on the south side

4) Noise meter

A noise meter shall be lent to the Contractor by the Engineer.

2.7 Vibration Survey

1) Items to be measured

Vibration level of L_{10} and L_{50}

2) Frequency of Survey

Vibration levels shall be measured and recorded every five seconds for ten minutes hourly from 6 am until 7 pm for three days at the two points indicated with a vibration level meter. Vibration levels corresponding to L_{10} and L_{50} shall be calculated from this data. The results shall be presented in an appropriate tabular/graphical form.

3) Survey points

A1: on Bagamoyo Road, 100-200 m north of the intersection with Sam Nujoma Road

A2: on Bagamoyo Road, near to the disposal site on the south side

4) Vibration meter

A vibration meter shall be lent to the Contractor by the Engineer.

2.8 Air quality survey on the access road

The air quality survey shall cover the following survey items: air temperature, humidity, wind direction, wind velocity, NH_3, SO_2, NO_x and CO. SO_2, NH_3, NO_x and CO will be measured using gas detector tubes. The analysis method shall be, in principle, either the method stipulated in the WHO standards or Japanese standards.

The air quality survey will be conducted at the same time and same two points as the traffic, noise and vibration surveys. All items shall be measured once every hour during the 10 min period when noise, vibration and traffic volume data is simultaneously collected from 6 am until 7 pm for three days at these two points. The total number of measurements will be as follows: once/hour x 13 times/day x 3 days x 2 points = 78.

2.9 Air quality survey at the proposed disposal site

The air quality survey shall cover the following survey items: air temperature, humidity, wind direction, wind velocity, settled dust, NH_3, SO_2, NO_x and CO. SO_2, NH_3, NO_x and CO will be measured using gas detector tubes. The analysis method shall be, in principle, either the method stipulated in the WHO standard or Japanese standard.

The air quality survey shall be conducted at two points near the cavity edge of the disposal site. All items, except dust, shall be measured at approximately monthly intervals, three times over a three month period at two points near the disposal site. Settled dust shall be measured over a 7

day continuous period once at two points during this three month period. The exact measurement location shall be instructed by the Engineer on site.

2.10 Land Use Survey

A land use survey shall be made of the area within the landfill site and to cover an area of radius 1 km outside the boundary of the disposal site. The exact area shall be instructed by the Engineer on site.

Land use development plans for the Kunduchi area shall also be obtained.

The results shall be presented in descriptive form together with a map of present and future land use.

2.11 Flora and Fauna Survey

A survey of flora and fauna shall be made of the area within the disposal site and to cover an area of radius 1 km outside the boundary of the disposal site. The exact area shall be instructed by the Engineer on site.

Any existing national, bilateral and/or multinational conventions on flora and fauna that Tanzania is party to shall be examined with relevant material from these conventions being discussed in the Contractor's report.

The results shall be presented in descriptive form together with a map showing the location and distribution of flora and fauna.

2.12 Hydrological Survey

The hydrological survey shall be divided into two parts.

Part I shall cover all surface water sources within the catchment area of the disposal site. Surface water flowrates shall be measured at approximately monthly intervals, three times over a three month period from two (2) points for each surface water source, one upstream and one downstream, of the disposal site.

Part II shall cover the groundwater table from the disposal site to the sea. The ground water table level shall be measured at approximately monthly intervals, three times over a three month period.

The exact area for each part shall be instructed by the Engineer on site.

Measurements shall be conducted after seven (7) continuous fine days and this work shall be conducted at the same time as samples are taken for water quality analysis.

Existing hydrological data shall be collected, well locations shall be mapped and the hydrological system analysed.

2.13 Water Use Survey

Water use from surface water and groundwater supplies shall be measured.

For groundwater, water use shall be determined for the disposal site area and downstream for a total area of approximately 2 sq.km. The exact area shall be instructed by the Engineer on site. A map showing the location of wells shall be produced.

For surface water, water use shall be determined from the disposal site to the sea for all surface water sources which may be affected by the disposal site. The exact area shall be instructed by the Engineer. The contractor shall specify the survey method to be used.

2.14 Public Health Survey

A Public Health Survey shall be conducted in order to assess the occurrence and incidence of diseases amongst residents in the vicinity of the disposal site, and to provide some baseline health data.

The area to be covered by this survey shall include all residents whose health is likely to be affected by the disposal site.

An interview survey of residents is not required for this purpose. Data collected from medical facilities in the locality will suffice. If this is not available, statistics for this area from DCC may be used.

2.15 Economic Survey

An Economic Survey shall be conducted in two parts:

Part I applies to the disposal site and has the following objectives:

- to determine the number of individual workers whose work will be affected by the disposal site and the type and scale of economic activities they are engaged in;
- to determine the status and scale of the Ministry of Works crushing plant operations within the boundary of the disposal site.

The objective of Part II is to assess the impact on the recycling system of shifting the disposal site:

- by analysing the middlemen, recycling and scavenger survey data that will be provided to the Contractor by the Engineer;
- by taking into account the policy decision on the recycling system in the Master plan and in particular, the decision on the presence of scavengers at the disposal site which the Contractor will be informed of by the Engineer;
- using any other relevant data.

The Contractor shall decide upon the methods to be used for each part.

2.16 Aesthetics

The Engineer shall provide the Contractor with a conceptual design summary for the disposal landfill together with an appropriate model of the completed facility.

The contractor shall assess the impact of the disposal site on the landscape and aesthetics. Comments on the role of the landscape in religion, culture, tourism, etc. in the area shall be included in this assessment.