

3.3 Cleansing Workers Survey

Findings from Cleansing Workers Survey in Badulla

A questionnaire survey was conducted among 30 municipal cleansing workers, in order to gather;

- A basic socio-economic profile of cleansing workers.
- An appreciation of working condition of municipal cleansing workers.

Period of survey: October 2nd, 3rd and 4th, 2002

Sample size: 30

1. General Questions

Q1-1 Gender

		Badulla	
		Number	%
1	Male	21	70%
2	Female	9	30%
Total		30	100%

Q1-2 Ethnicity

		Badulla	
		Number	%
1	Sinhala	19	63%
2	Muslim	0	0%
3	Tamil	11	37%
4	Other	0	0%
Total		30	100%

Q1-3 Religion

		Badulla	
		Number	%
1	Buddhist	19	61%
2	Islam	0	0%
3	Hindu	9	29%
4	Christian	3	10%
5	Other	0	0%
Total		31	100%

Q1-4 Household information

(person)	Badulla
Avg. number of family members	5.1

(Rs.)	Badulla
Avg. household income	8,136

(Rs.)	Badulla
Income per person	1,606

Q1-5 How much is the total expenditure of your household per month on average?

(Rs.)	Badulla
Avg. household expenditure	7,150

(Rs.)	Badulla
Expenditure per person	1,411

Q1-6 Please specify the priority for your daily life regarding the improvement of the following aspects?

	Badulla	point
1 First Water supply		40
2 Second Access road to their houses		27
3 Third Others (Toilet / housing problems)		25
4 Fourth Storm water drainage		24
5 Fifth Wastewater collection		14
6 Sixth Garbage collection		13
7 Seventh Electricity supply		1

Note: Interviewees are asked to answer three most prioritized matters among the seven choices mentioned above, and the total points are calculated by adding up three to the most prioritized matters, two to the second priority and one to the third priority.

2. Questions about Your Work

Part A : Status and Wage

Q2-1 Are you a permanent worker or a casual worker?

	Badulla	
	Number	%
1 Permanent	29	97%
2 Casual	1	3%
3 Kangani	0	0%
Total	30	100%

Q2-2 How long have you been doing this job?

(years)	Badulla
Average working years	16.1

Q2-3 How many days do you usually work per week?

(days)	Badulla
Average working days per week	6.1

Q2-4 How many hours do you usually work per day?

(hours)	Badulla
Average working hours per day	7.0

Q2-5 Had either your father or mother done this same job?

		Badulla	
		Number	%
1	Yes	14	47%
2	No	16	53%
Total		30	100%

Q2-6 How much is your monthly wage on average (including official allowance such as holiday pay, overtime and so on)?

(Rs)	Badulla
Average monthly income	5,534

Q2-7 Do you have any secondary jobs after working hours?

		Badulla	
		Number	%
1	Yes	8	27%
2	No	22	73%
Total		30	100%

Q2-8 How often and what type of work do you do as a secondary job?

- (1) How often: Frequency varies from every day to a few times per month.
- (2) Type of work: Labor work such as cleaning houses and toilets, cleaning gardens, shoe repairing and so on.

Q2-9 How much is your monthly wage on average from this secondary resource?

(Rs)	Badulla
Average monthly income from secondary job	1,050

Note: Number of effective answers are 8.

Q2-10 Are there some waste generators which give you small allowance, including the reward to your extra cleaning work?

		Badulla	
		Number	%
1	Yes	15	50%
2	No	15	50%
Total		30	100%

Q2-11 How much is your income from small allowance per month on average?

(Rs)	Badulla
Average monthly allowance from waste generators	23

Note: Number of effective answers are 15.

Q2-12 Do you know other solid waste laborers who sometimes receive a small allowance?

		Badulla	
		Number	%
1	Yes	13	43%
2	No	8	27%
98	Don't know	9	30%
Total		30	100%

Q2-13 Do you collect recyclable materials from waste for sale?

		Badulla	
		Number	%
1	Yes	9	30%
2	No	21	70%
Total		30	100%

Q2-14 If yes to Q2-13, what materials do you collect, how much do you collect per month and who do you sell them to?

		Badulla	
		Number	%
1	Bottle	8	21%
2	Iron	2	5%
3	Aluminum	2	5%
4	Tin	4	10%
5	Copper	0	0%
6	Other metal	0	0%
7	Paper	0	0%
8	Cardboard	2	
9	Irrelevant	21	54%
Total		39	100%

(Rs.)	Badulla
Average monthly income from recycling	99

Note: Number of effective answers are 9.

Part B : Working Conditions and Technical Problems

Q2-15 These are the possible difficulties you may face. Please prioritize your difficulties?

Badulla		(points)
1	Heavier workload and unhealthier conditions due to the improper discharge as waste by people	28.0
2	Unsanitary waste such as human waste / excrement is mixed with other waste	27.0
3	Heavier workload for you due to absenteeism among your colleagues	13.0
4	Heavier workload for you due to alcoholism among your colleagues	0.0
5	Insufficient wage	33.0
6	Health problems	22.5
7	The working schedule such as allocation of vehicles and routes are so changeable	9.0
8	Lack of protecting clothing (boots, gloves, apron and so on)	68.0
9	Vehicle often breakdown	34.0
10	Not enough tools for collection work	28.0
11	Vehicle parked on the street makes your work more difficult	18.5
12	Others	10.5
Total		291.5

Note : Others are "large area to be covered by one laborer".

Interviewees are asked to prioritize six difficulties among the twelve choices mentioned above, and the total points are calculated by adding up 3 to the most prioritized matters, 2.5 to the second one, 2 to the third one, 1.5 to the fourth one, 1 to the fifth one and 0.5 to the sixth one.

Q2-16 Are there any particular areas of the city where you feel difficult to collect garbage?

		Badulla	
		Number	%
1	Yes	17	57%
2	No	13	43%
Total		30	100%

Q2-17 If yes to the previous question, what are the reasons of difficulties?

		Badulla	
		Number	%
1	Improper discharge of waste by people	5	14%
2	Physically difficult work	8	22%
3	Large amount of garbage	2	6%
4	Traffic and many people	5	14%
5	Road conditions	2	6%
6	Other	1	3%
98	Don't know	0	0%
99	Irrelevant	13	36%
Total		36	100%

Note: Other means "not enough collection points".

Q2-18 When difficulties relating to your work arise, whom you talk to first? (**Choose only one.**)

	Badulla	
	Number	%
1 Officer in charge such as PHI and MOH	2	7%
2 Supervisor	19	63%
3 Minor supervisor	0	0%
4 Colleagues	9	30%
5 Others	0	0%
Total	30	100%

Q2-19 How do you think MC / UC can improve the garbage collection system? Please give your honest opinion.

	Badulla	
	Number	%
1 Household / citizens contribution	0	0%
2 Need salary increase	4	7%
3 Need more workers	18	31%
4 Need awareness program	1	2%
5 Need more equipments / vehicles	17	29%
6 Health protection incl. introducing protecting clothing	8	14%
7 Others	10	17%
Total	58	100%

Note: Other means "should repair broken vehicles immediately" "need proper supervision", "should introduce modernized garbage collection system", "MC should provide transportation and other benefits" and so on.

3.4 Middlemen Survey

3.4.1 Survey Sheet

Middlemen and Micro-industries Recycling Survey

Interviewer:		Date:	
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General Information:

Name of Interviewee:	
Position of Interviewee:	
Name of Business:	
Address/location:	
No of Years of Operation:	

Nature of Business:

a) What are the main activities of your business?

Recycling Activities Collection Details

3.1 What materials do you recycle and in what condition? *(please circle the materials recycled and their condition in the table below)*

Materials	Condition				
	Plastics	Mixed, unwashed	Sorted, unwashed	Sorted, clean	Other
Polythene	Mixed, unwashed	Sorted, unwashed	Sorted, clean	Other	
Bags	Polysacks	Flour bags	Poultry feed bags	Sugar bags	Other
Paper	Old newspapers	Old exercise books	White paper	Cardboard/boxes	Other
Glass	Whole Arrack bottles	Whole beer bottles	Other whole bottles/jars	Broken bottles	Other
Metals	Aluminium	Beer cans	Copper/brass	Ferrous	Other
Tyres	Small			Large	
Other	Old battery cases (washed, cleaned)		Wood	Other	

Please describe what "other" means below:

.....

- 3.2 Who collects these recyclable materials for you? (tick one or more and describe the type of wastes to which they apply)
- | | <i>Tick</i> | <i>Waste Types</i> |
|--|-------------|--------------------|
| (a) Individuals | [] | |
| (b) You and/or some of your workers | [] | |
| (c) LA/private contractor garbage collection labourers | [] | |
| (d) Community groups/non-governmental organizations | [] | |
| (e) Middlemen | [] | |
| (f) Other – describe: | [] | |

- 3.3 What are the main sources these recyclable materials come from? (fill in the table with the materials you recycle, the main sources and the approximate percentages from these sources if you know them)

Materials	Main sources			
	First	Second	Third	Others
<i>e.g. Cardboard</i>	<i>C (75%)</i>	<i>M (15%)</i>	<i>Ht (5%)</i>	<i>S, GO (5%)</i>

Use the following codes:

H	Households	Ht	Hotels	Hp	Hospitals
C	Commercial enterprises (e.g. shops, banks, etc.)	GO	Government offices	I	Industries
M	Markets	S	Schools	O	Other

Please describe what "other" means below:

.....

- 3.4 Where do these recyclable materials come from and what is the approximate percentage of materials collected from each area?
- | | <i>Tick</i> | <i>%</i> |
|---|-------------|----------|
| (a) Within Urban/Municipal Council Area | [] | [] |
| (b) Within District | [] | [] |
| (c) Within Province | [] | [] |
| (d) Other Areas – describe: | [] | [] |

- 3.5 Fill in the table below with the following information:
- (a) On average, how many units (kg, items, etc.) of these recyclable materials do you collect per month?
 - (b) How much do you pay for such materials per unit (Rs/kg, Rs/item, etc.)?
 - (c) Is your demand for these materials stable?
 - (d) Is the supply greater than or less than your demand?
- Please add any relevant comments on demand/supply issues for these materials below the table.

Material	Quantity	Price paid	Total payment (Rs/mth)	Demand stable	Supply vs. demand
<i>e.g. Clean, sorted plastics</i>	<i>80kg/mth</i>	<i>5Rs/kg</i>	<i>400 Rs</i>	<i>Yes</i>	<i>Greater</i>
Total payment					

Comments:.....
.....

Worker Details

In the table below, indicate the number of full-time and part-time workers, including yourself, and in each case, the average number of hours worked per week and days worked per month **on the recycling activities** carried out by your business.

Table 2 : WorkerDetails

Workers	No	Hrs worked per wk on recycling activities	Days worked per month on recycling activities
Manager/owner			
Full-time worker			
Part-time worker			

Recycling Activities Processing/Sales Details (fill in Table 3 with answers)

- 5.1 What do you do with these materials? (*tick one or more and describe the types of waste to which they apply*)
- | | <i>Tick</i> | <i>Waste Types</i> |
|--|-------------|--------------------|
| (a) Transport directly to factories | [] | |
| (b) Pre-process (e.g. sort, wash, dry) and transport to factories | [] | |
| (c) Process (e.g. grind, pelletise, etc.) and transport to factories | [] | |
| (d) Use as raw materials for making other products | [] | |
| (e) Other – describe: | [] | |

- 5.2 If you ticked (d) in Q5.1, what products do you make from these materials?
-
.....

5.3 Who do you sell these materials and/or the products you make from them to? Where relevant (e.g. commercial, industrial), specify the name, location and how far away are these places are located.

Customers	Materials sold	Name	Location	Distance (km)
Individuals				
Commercial enterprises (e.g. shops, markets)				
Tourists				
Factories for further processing				
Other				

Please describe what "other" means:

.....

Fill in the table below with the following information:

- (a) How many units (kg, items) of these materials and/or products do you sell per month?
- (b) How much do you sell these materials and/or the products you make from them for?
- (c) Is the demand for any products you make from these materials small, medium or large?

Material	Quantity	Sales Price	Income (Rs/mth)	Demand
<i>e.g. Plastic pellets</i>	<i>50kg/mth</i>	<i>40Rs/kg</i>	<i>2,000</i>	<i>Medium</i>
Total income:				

Comments:

.....

What is your average expenditure and income per month from these recycling activities:

Average operating expenses = Rs/mth
 Average income = Rs/mth
 Net income = Rs/mth

What are the main costs incurred by your business in these recycling activities?; and what is the approximate percentage total costs in each category? (tick all that apply and estimate the approximate percentages of the five main types. If you do not know this, just rank the five main types, 1 = highest, 2 = 2nd highest, etc.) Tick % or rank

- (a) Buying the recyclable materials [] []
- (b) Storage prior to transportation [] []
- (c) Transportation [] []
- (d) Labour [] []
- (e) Other raw materials (e.g. chemicals, additives) [] []
- (f) Utilities (electricity, water, telephone, etc.) [] []
- (g) Land/building rental [] []

- | | | |
|-----------------------------|-----|-----|
| (h) Machinery maintenance | [] | [] |
| (i) Other – describe: | [] | [] |

Other Information

How much waste do you produce from your recycling activities per month?

Answer: kg/mth

What do you do with the waste from your recycling activities? (*tick one or more*)

- | | |
|---|-----|
| (a) All waste is recycled | [] |
| (b) Collection by LA/private contractor | [] |
| (c) Bury/burn on property | [] |
| (d) Other - describe: | [] |

What are the main issues/problems facing your recycling activities? (*tick all that apply and rank up to the five most serious problems, 1 = worst, 2 = 2nd worst, etc.*)

	<i>Tick</i>	<i>Rank</i>
(a) Shortage of recyclable materials	[]	[]
(b) Contamination/poor quality of recyclable materials	[]	[]
(c) High land/building rental costs	[]	[]
(d) Excessive transportation costs	[]	[]
(e) Unstable demand for recyclable materials and/or products	[]	[]
(f) Utilities problems (e.g. electricity cuts, no water, etc.)	[]	[]
(g) Loss of market (e.g. collapse of tourism)	[]	[]
(h) Difficulties in obtaining credit	[]	[]
(i) Other - describe:	[]	[]

Comment on what could be done to help solve these problems/issues?

.....

Any other comments/useful information?

.....

Notes for interviewer:

1. Check that quantities collected for recycling tally with quantities sold on to others, where relevant.
2. Check that costs and income tally with quantities and indicated sales prices.

3.4.2 Result 1

Middlemen			1	1	2	3.1																
ID No	Business name	Address/location	Opn Yrs	Main activities	Plas																	
					Polythene				Bags				Paper				Glass					
					MU	MU	SC	Tot	PS	FB	SB	Tot	NP	EB	CB	Tot	Arr	BB	BJ	Br	Tot	
MMB1	Ravi Stores	Mr. Rasik, 297 Muthiyangana Rd, Badulla	4	Buying/selling recycl.																		
MMB2	NA	Mr. P Meeganadan, 16/2, Station Rd, Viharagoda	10	Buying/selling recycl.	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	
MMB3	S.L. Stores	Mr. W Tiruchelwam, 235/B, Pahala Veediya, Badulla	0.5	Buying/selling recycl.						Y	Y	Y					Y	Y			Y	
MMB4	NA	Mr. Rajeendran, Station Rd, Badulla	8	Buying/selling iron																		
MMB5	Susil Trade Centre	Mr. A. Sundaralingam, 24 Station Rd, Badulla	1.5	Buying/selling recycl.					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
MMB6	Dharma Stores	Mr. J S Fernando, 279, Passara Rd, Badulla	0.5	Buying/selling recycl.									Y	Y	Y	Y	Y	Y	Y	Y	Y	
MMB7	NA	Mr S Ganeshan Murthi, 4 Church Rd, Badulla	0.5	Buying/selling recycl.		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
MMB8	Sanmugam Sons	Mr. Karapayya Sanbun, 17/A, Mosque Rd, Badulla	10	Buying/selling recycl.									Y	Y	Y	Y	Y	Y		Y	Y	
Total		Total no of middlemen surveyed	8	No	1				1	4	4	4	6	4	3	6	5	5	2	4	8	

Notes:

1. Cells containing formulae shaded in light blue - do not use.
2. NA = no answer; IR = irrelevant

ID No	Metals					3.2 Collectors							3.3 Main sources																														
	Al	BC	CB	Fe	Tot	Oth	Pl	Po	Ba	Pa	Gl	Me	Ba	Tot	Plastic (%)					Polythene (%)				Bags (%)				Paper/cardboard (%)						Broken glass (%)									
															H	Ht	C	I	O	H	Ht	C	I	H	Ht	C	I	H	Ht	C	Go	S	I	O	H	Ht	C	I	O				
MMB1	Y	Y	Y	Y	Y	Y	E		E	E	E	E	E	E	E																												
MMB2	Y	Y	Y	Y	Y	Y	E		E	E	E	E	E	E	E																							30	40	20	0	10	
MMB3	Y	Y	Y	Y	Y	Y			B,E	E	B,E	B,E	B,E	B,E	B,E																												
MMB4	Y	Y	Y	Y	Y	Y					E	E	E	E	E																												
MMB5	Y	Y	Y	Y	Y	Y			B,E	B,E	B,E	B,E	B,E	B,E	B,E																							40	0	0	60	0	
MMB6	Y	Y	Y	Y	Y	Y				E	E	E	E	E	E																							70	30	0	0	0	
MMB7	Y	Y	Y	Y	Y	Y			B,E	B,E	B,E	E	E	E	E																							0	0	40	60	0	
MMB8	Y	Y	Y	Y	Y	Y			E	E	E	E	E	E	E																							0	0	0	0	0	
Total	8	8	8	7	7	5																																50	30	0	20	0	
Count														Wt avg														Avg															
A	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	0	0	0	0	0	0	0	0	0	0	0	50	30	0	20	0	
B	0	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	
C	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
D	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
E	1	1	4	5	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7			
F	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sum =														Sum =														Sum =															
100														100														100															

Qtys of different materials collected by different middlemen used in calculating weighted average sources (%) in Q3.3

	Pl	Poly	Bg	P/C	Glass			Me	Ba
					Br	Bo	Tot		
MM1	0	0	0	300	0	0	0	565	0
MM2	4500	0	3500	11200	2000	4000	5000	5580	3000
MM3	0	0	2250	0	0	4000	4000	7080	1500
MM4	0	0	0	0	0	0	0	3000	0
MM5	0	0	2500	1300	200	800	1000	5450	0
MM6	0	0	0	100	900	500	1000	300	80
MM7	0	1300	20000	2200	0	0	0	0	0
MM8	0	0	0	375	10000	550	10550	5350	300
Total	4500	1300	29250	15475	12700	8650	22550	27305	4850

Must adjust this table after entering data to eliminate any values for which there is NA in Q3.3 - do manually
Adjusted cells shaded in orange

ID No	3.4 Coll'n area (%)					4. Worker details												5.1 Processing																				
	GI bottles (%)					Metals (%)				Batteries (%)				Prop (%)	3.4 Coll'n area (%)				4. Worker details				Total H/mth	Equip FT	Pl	Pol	Ba	Pa	Gi	Me	Oth							
	H	Ht	C	I	O	H	C	I	O	H	I	C	O		A	B	C	D	Manager/owner	Full-time workers		Part-time workers																
														No	Hr/wk	d/mth	No	Hr/wk	d/mth	No	Hr/wk	d/mth																
MMB1						20	0	80	0					0.4	60	10	30	0	2	108	25	0					386	1.9				R,WS						
MMB2	30	40	20	0	10	40	0	10	50	70	0	30	0	30.9	20	70	10	0	2	84	30	0			2	36	12	422	2.0	R,WS		R,WS	A	R,WS	R,WS	R,WS		
MMB3	80	0	20	0	0	40	0	60	0	50	0	0	50	20.5	0	80	20	0	6	336	30	2	112	30	1	24	12	1961	9.4			WS		WS	WS	WS	WS	
MMB4						50	0	0	50					1.8	40	60	0	0	2	120	25	0			0			429	2.1							R,WS		
MMB5	40	0	0	60	0	80	20	0	0					9.2	60	30	10	0	1	42	25	0			0			150	0.7			R,WS	R,WS	R,WS	R,WS	R,WS	R,WS	
MMB6	70	30	0	0	0	40	0.0	10	50	100	0	0	0	2.2	20	80	0	0	2	96	26	0			1	32		357	1.7			R,WS	R,WS	R,WS	R,WS	R,WS	R,WS	
MMB7														25.2	80	20	0	0	2	140	30	0			3	24	4	614	3.0		R,WS,A	R,WS,A	R,WS,A	R,WS,A	R,WS	R,WS		
MMB8	60	0	40	0	0	100	0	0	0	100	0	0	0	9.9	80	20	0	0	4	240	25	0			2	64	16	1003	4.8			R,WS	A	R,WS	R,WS	R,WS		
Total	58	14	18	12	2	53	3	23	21	80	0	8	13	Avg	41.2	50.6	8.2	0.0	21							8			5321	25.6								
	54.8	17.8	19.5	4.9	4.1	60.4	4.0	19.3	16.3	68.0	0.0	18.5	15.4																									
	Sum: 100					Sum: 100				Sum: 100																												

Assume equiv FT worker = 208 h/mth in private sector (8h/d x 26d/mth)

"Prop" column lists proportion of materials collected from different sources, as calculated in purchases sheet - used for calculating weighted averages in Q3.4

R = retail	1	1	3	5	3	8	4
WS = w/sale	1	0	3	4	4	7	5
A	0	0	0	1	1	0	0
B	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
NA	0	0	0	0	0	0	0
IR	0	0	0	0	0	0	0

ID No	5.2		5.3					5.5 Profit Exp and Income check						5.6 Main Costs											
	Products	PI	Poli	Ba	Pa	Gl	Me	Oth	Name, location, distance (km)	Expenditure	Income	Net income	Recycl Payment	Recycl Sales	Net income	A	B	C	D	E	F	G	H	I	
MMB1	IR			In,Ws			In,Ws		DK	NA	NA	NA	8700	10350	1850	1	2	3			4				
MMB2	IR	In,Ws		In,Ws	F	In,Ws	In,Ws	In,Ws	NPC,Walachchena	200000	210000	10000	199950	318850	119900	1		2	5		3	4			
MMB3	IR			Ws		Ws	Ws	Ws	Colombo	175000	185000	10000	169025	189200	20175	1					3	4			
MMB4	IR						In		DK	15000	20000	5000	15000	18500	4500	1		4			2	3			
MMB5	IR			In,Ws	In,Ws	In,Ws	In,Ws	In,Ws	NA	NA	NA	96940	119790	13810	1		4			3	2				
MMB6	IR			In,R	In,R	In,R	In,R	In,R	NA	11000	15000	4000	12450	14910	2460	1		2	5		3	4			
MMB7	IR	In,WS		In,WS	In,WS	In,WS	In,WS	In,WS	NPC,Walachchena	30000	40000	10000	118500	151050	32550	1	5	2	3			4			
MMB8	IR			In,Ws		In,Ws	In,Ws	In,Ws	CGC, Ratmalana	90000	100000	10000	92598	113050	20452	1		2	2		5	4			
Total				Ci					Total	521000	NA	NA	712153	927660	215508										

In	1	1	3	5	4	6	4
Ws	1	1	4	4	4	5	4
R	0	0	0	1	1	1	1
F	0	0	0	1	0	0	0
Oth	0	0	0	0	0	0	0
IR	0	0	0	0	0	0	0
NA	0	0	0	0	0	0	0
Sum	2	2	7	11	9	12	9

Use "In" for individuals

From comparison of recyclables and purchases data, suspect data identified (shaded in orange)

From recyclables purchases and sales data

Rank	A	B	C	D	E	F	G	H	I
1	2.5	8	0	0	0	0	0	0	0
2	2	0	1	5	1	0	1	1	0
3	1.5	0	0	1	1	0	4	1	0
4	1	0	0	2	0	0	1	5	0
5	0.5	0	1	0	2	0	1	0	0
Sum	8	2	8	4	0	7	7	0	0
Wt avg	20.0	2.5	13.5	4.5	0.0	9.5	8.5	0.0	0.0

5.5

MMB1 also doing another business so can't say

ID No	Qty (kg/mth)	Actor	6.3 Main problems									Comments on how to solve these problems + other			
			A	B	C	D	E	F	G	H	I				
MMB1	50	D	IR										NA		
MMB2	15	D				3						2	1	Give aid or low interest rate loan	
MMB3	30	D			3	1						2		Give recycling factory to Badulla	
MMB4	6.25	D	1										2	NA	
MMB5	25	D	3		4	5		1	2					Construct recycling plant near Badulla, loans needed	
MMB6	6.5	D	2		6	5		4			3		1	Give aid or low interest rate loan	
MMB7	150	D	5			3		1	4	2				Give aid or low interest rate loan, Storage/transport	
MMB8	25	D	5			3		2	4	1				Give aid/low interest rate loan, storage facilities, mkt in Badulla	
Total															
		Rank	A	B	C	D	E	F	G	H	I				
	1	2.5	1	0	0	1	0	2	0	1	2				
	2	2	1	0	0	0	0	1	1	3	1				
	3	1.5	1	0	1	3	0	0	0	1	0				
	4	1	0	0	1	0	0	1	2	0	0				
	5	0.5	2	0	0	2	0	0	0	0	0				
		Sum	5	0	2	6	0	4	3	5	3				
		Wt av	7.0	0.0	2.5	8.0	0.0	8.0	4.0	10.0	7.0				MM8 - market in Badulla comment means developing a market to sell all the items to in Badulla.

6.2

MMB1,2,3 Give to BMC collection service
MMB4 Direct disposal system

6.3

MMB2 Loan interest problem
MMB4 Thieves problem
MMB6 Security problems

3.4.3 Result 2

Section	1 3.1 3.5																																	
ID No	Business name	Plastics								Polythene								Bags						Newspaper										
		Code	Qty	Unit	Price	Unit	Total	Dem	SvD	Code	Qty	Unit	Price	Unit	Total	Dem	SvD	Code	Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD		
MMB1	Ravi Stores					0																												
MMB2		MU	4500	kg	8	/kg	36000	Y	L									FB	2000	bags	7	ea	14000	N	H	200	kg	12	/kg	2400	Y	H		
MMB3	S.L. Stores					0												SB	1500	bags	3	ea	4500	N	H		kg		/kg	0				
MMB4						0												FB	2000	bags	7	ea	14000	Y	L		kg		/kg	0				
MMB5	Susil Trade Centre					0												SB	250	bags	3.5	ea	875	N	H		kg		/kg	0				
MMB6	Dharma Stores					0												FB	500	bags	6	ea	3000	Y	Avg	1000	kg	6	/kg	6000	Y	L		
MMB7	NA					0				MU	900	kg	2	/kg	1800	Y	L	FB	10000	bags	6.5	ea	65000	Y	L		kg		/kg	0				
MMB8	Sanmugam Sons					0				SC	400	kg	4	/kg	1600	Y	L	SB	10000	bags	4	ea	40000	Y	L	200	kg	18	/kg	3600	Y	L		
	Total		4500	kg		36000	Rs				1300	kg		3400	Rs				28250	bags		ea	155375	Rs		1875	kg		/kg	16025	Rs			

Notes:

1. Blue shaded cell indicates no quantity or cost information given (NA inserted in units column rather than qty column, as the latter upsets the spreadsheet calculations)
2. Green shaded cell indicates data that has been modified so that sales and purchases figures are consistent.
3. NA = no answer

Section	ID No	Exercise books						Cardboard/boxes						Broken glass						Arrack/beer/other bottles						Metals - ferrous															
		Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD	Code	Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD				
	MMB1		kg		/kg	0					/kg	0																													
	MMB2	1000	kg	1.5	/kg	1500	Y	L	10000	kg	2.5	/kg	25000	Y	L	2000	kg	0.5	/kg	1000	Y	L	Ar/Beer	4000	bottles	4.5	ea	18000	Y	L	5000	kg	6	/kg	30000	Y	L				
	MMB3		kg		/kg	0				kg		/kg	0				kg		/kg	0			Ar/Beer	4000	bottles	5	ea	20000	Y	L	6000	kg	7	/kg	42000	Y	L				
	MMB4		kg		/kg	0				kg		/kg	0				kg		/kg	0					bottles		ea	0			3000	kg	5	/kg	15000	Y	L				
	MMB5	200	kg	8	/kg	1600	Y	L	100	kg	3		300	Y	L	200	kg	1		200	Y	L	Ar/Beer	800	bottles	6	ea	4800	Y	L	5000		7		35000						
	MMB6		kg		/kg	0				kg		/kg	0			500	kg	1.5	/kg	750	Y	L	Ar/Beer	500	bottles	3.5	ea	1750	Y	L	200	kg	7	/kg	1400	Y	L				
	MMB7		kg		/kg	0				kg		/kg	0				kg		/kg	0					bottles		ea	0				kg		/kg	0						
	MMB8	300	kg	4.5	/kg	1350	Y	L	1500	kg	3	/kg	4500	Y	L	10000	kg	2.5	/kg	25000	Y	L	Ar/Beer	550	bottles	4.75	ea	2613	Y	L	5000	kg	7.5	/kg	37500	Y	L				
		2000	kg		/kg	6450	Rs		11800	kg		/kg	29800	Rs		12700	kg		/kg	26950	Rs						ea	47163	Rs		24700	kg			164400	Rs					
																								9850	bottles																

Section																				Total quantities				Prop'n of total (%)													
ID No	Metals - copper/brass						Metals - Aluminium						Metals - Beer Can						Batteries			Bottles	Bags		Kg	Payments (Rs)											
	Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD	Qty	Unit	Price	Unit	Total	Dem	SvD									
MMB1	40	kg	70	/kg	2800	Y	L	20	kg	60	/kg	1200	Y	L	5	kg	60	/kg	300	Y	L		kg		/kg	0							0	0	885	8700	0.4
MMB2	250	kg	70	/kg	17500	Y	L	300	kg	60	/kg	18000	Y	L	30	kg	35	/kg	1050	Y	L		3000	kg	10	/kg	30000	Y	L				4000	3500	26280	198960	30.9
MMB3	300	kg	80	/kg	24000	Y	L	750	kg	70	/kg	52500	Y	L	10	kg	65	/kg	650	Y	L		1500	kg	10	/kg	15000	Y	L				4000	2250	8560	189025	20.5
MMB4		kg		/kg	0						/kg	0				kg		/kg	0					kg		/kg	0				0	250	3000	15000	1.8		
MMB5	200		90		18000	Y	L	200		60		12000	Y	L	50		30		1500	Y	L		60		9		540	Y	L				800	2500	7010	96940	9.2
MMB6	.30	kg	80.0	/kg	2400	Y	L	50		65	/kg	3250	Y	L	20	kg	15	/kg	300	Y	L		60	kg	10	/kg	600	Y	L				500	0	960	12450	2.2
MMB7		kg		/kg	0						/kg	0				kg		/kg	0					kg		/kg	0					0	20000	3500	118500	25.2	
MMB8	100	kg	75.0	/kg	7500	Y	L	200		65	/kg	13000	Y	L	50	kg	30	/kg	1500	Y	L		300	kg	10	/kg	3000	Y	L				550	0	18025	92568	9.9
	920	kg			72200	Rs		1520	kg			99950	Rs		188	kg			5300	Rs			4920	kg			49140				9850	28500	66200	712153	100		

1. Proportion column calculates the proportion of total materials collected by different enterprises as (no of bottles/total bottles + no of bags/total bags + kg/total kg)/3 x 100%
- used in general spreadsheet

3.4.4 Result 3

		3.1		5.4		Plastics				Polythene				Various bags				Newspaper										
ID No	Business name	Code	Qty	Unit	Price	Unit	Total	Dem	Code	Qty	Unit	Price	Unit	Total	Dem	Code	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem
MMB1	Ravi Stores						0																					
MMB2		MU	4500	kg	15		67500	H								FB	2000	bags	8.5	ea	17000	L	200	kg	4.5	/kg	900	L
							0									SB	1500	bags	5	ea	7500	L						
MMB3	S.L. Stores						0									FB	2000	bags	7.5	ea	15000	H						
							0									SB	250	bags	4	ea	1000	Me						
MMB4							0																					
MMB5	Susil Trade Centre						0									FB	2000	bags	7.5	ea	15000	L						
							0									SB	500	bags	6.5	ea	3250	L	1000	kg	7.5	/kg	7500	L
MMB6	Dharma Stores						0																					
MMB7	NA						0		MU	900	kg	8	/kg	7200	Me	FB	10000	bags	7.5	ea	75000	L	200	kg	18	/kg	3600	Me
							0		SC	400	kg	10	/kg	4000	Me	SB	10000	bags	5	ea	50000	L						
MMB8	Sanmugam Sons						0																					
							0																					
	Total		4500	kg			67500	Rs		1300				11200			28250	bags		ea	183750	Rs	1875	kg		/kg	18500	Rs

Notes:

1. Blue shaded cell indicates no quantity or cost information given (NA inserted in units column rather than qty column, as the latter upsets the spreadsheet calculations)
2. Green shaded cell indicates data that has been modified so that sales and purchases figures are consistent.
3. NA = no answer

ID No	Paper - exercise books						Cardboard						Broken glass						Glass - Arrack/beer/other bottles						Metals - ferrous							
	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem	Code	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem	
MMB1		kg		/kg	0			kg		/kg	0			kg		/kg	0				Bott		ea	0		500	kg		8	/kg	4000	Me
MMB2	1000	kg	7	/kg	7000	Me	10000	kg	6.25	/kg	62500	H	2000	kg	1	/kg	2000	Me	Arr/Beer	4000	Bott	7.5	ea	30000	Me	5000	kg	7.5	/kg	37500	H	
MMB3		kg		/kg	0			kg		/kg	0			kg		/kg	0		Arr/Beer	4000	Bott	6	ea	24000	Me	6000	kg	8	/kg	48000	Me	
MMB4		kg		/kg	0			kg		/kg	0			kg		/kg	0				Bott		ea	0		3000	kg	6.5	/kg	19500		
MMB5	200	kg	10	/kg	2000	Me	100	kg	3.5	/kg	350	L	200	kg	1.5	/kg	300	Me	Arr/Beer	800	Bott	7.5	ea	6000	Me	5000	kg	8	/kg	40000	Me	
MMB6		kg		/kg	0			kg		/kg	0		500	kg	2	/kg	1000	L	Arr/Beer	500	Bott	6	ea	3000	L	200	kg	8	/kg	1600	L	
MMB7	500	kg	6	/kg	3000	Me	1500	kg	5.5	/kg	8250	Me		kg		/kg	0				Bott		ea	0			kg		/kg	0		
MMB8	300	kg	6	/kg	1800	Me		kg		/kg	0		10000	kg	3.5	/kg	35000	L	Arr/Beer	550	Bott	6	ea	3300	Me	5000	kg	8.5	/kg	42500	L	
	2000	kg		/kg	13800	Rs	11600	kg		/kg	74100	Rs	12700	kg		/kg	38300	Rs		9850	Bott		ea	66300	Rs	24700	kg		/kg	193100	Rs	

ID No	Metals - copper/brass						Metals - Aluminium						Metals - Beer Can						Batteries						Total quantities									
	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem	Qty	Unit	Price	Unit	Total	Dem	Bottles	Bags	Kg	Sales (Rs)						
MMB1	40	kg	80	/kg	3200	Me	20	kg	72	/kg	1440	Me	5	kg	72	/kg	360	Me		kg		/kg	0								0	0	865	10350
MMB2	250	kg	100	/kg	25000	H	300	kg	68	/kg	20400	H	30	kg	45	/kg	1350	H	3000	kg	12.5	/kg	37500	H							4000	3500	26280	318850
MMB3	300	kg	90	/kg	27000	Me	750	kg	75	/kg	56250	Me	10	kg	70	/kg	700	L	1500	kg	11.5	/kg	17250	Me							4000	2250	8560	189200
MMB4		kg		/kg	0			kg		/kg	0			kg		/kg	0			kg		/kg	0								0	0	3000	19500
MMB5		kg		/kg	0			kg		/kg	0			kg		/kg	0			kg		/kg	0								800	2500	7010	110750
MMB6	200	kg	100	/kg	20000	Me	200	kg	70	/kg	14000	Me	50	kg	35	/kg	1750	Me	60	kg	10	/kg	600	Me							500	0	960	14910
MMB7	30	kg	85	/kg	2550	L	50	kg	70	/kg	3500	L	20	kg	25	/kg	500	L	60	kg	11	/kg	660								0	20000	3500	151050
MMB8		kg		/kg	0			kg		/kg	0			kg		/kg	0			kg		/kg	0								0	0	16025	113050
	100	kg	87.5	/kg	8750	Me	200	kg	75	/kg	15000	Me	50	kg	35	/kg	1750	Me	300	kg	12	/kg	3600	Me							550	0	6625	113050
	920	kg		/kg	86500	Rs	1520	kg		/kg	110580	Rs	165	kg		/kg	6410	Rs	4920	kg		/kg	56810	Rs	8650	28250	66200	927660						

3.4.5 Data summary for graphs

Q3.3

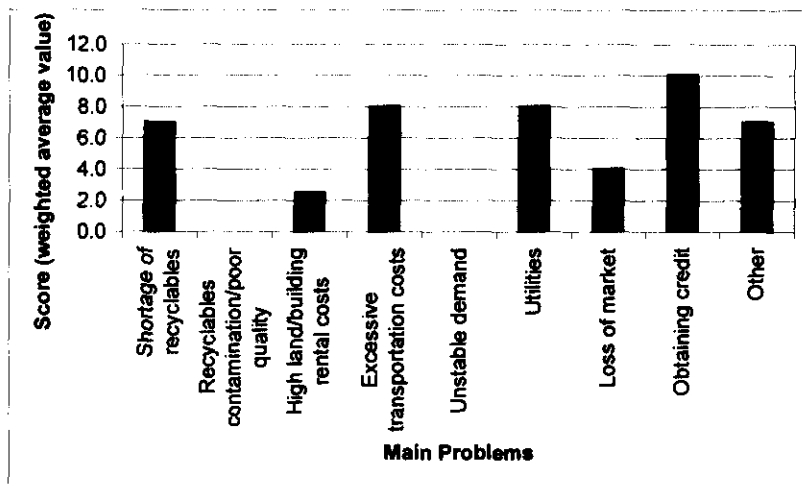
	Main sources (%)								
	Plastic	Polythene	Bags	Pa/card	Broken gla	Glass bottl	Metals	Batteries	
Households	50.0	0.0	1.6	54.8	55.4	54.8	60.4	66.0	
Hotels	30.0	0.0	0.0	0.0	7.5	17.6	0.0	0.0	
Hospitals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Commercial	0.0	40.0	98.4	39.5	34.6	16.5	4.0	18.5	
Markets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Schools	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Government offices	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	
Industries	20.0	60.0	0.0	0.0	0.9	4.9	19.3	0.0	
Other	0.0	0.0	0.0	0.0	1.6	4.1	16.3	15.4	
	100		100.0	100.0	100.0	100.0	100.0	100.0	

Q5.6

	Rank	1	2	3	4	5	Wt avg
A	Purchases	8	0	0	0	0	20.0
B	Storage	0	1	0	0	1	2.5
C	Transportation	0	5	1	2	0	13.5
D	Labour	0	1	1	0	2	4.5
E	Other raw materials	0	0	0	0	0	0.0
F	Utilities	0	1	4	1	1	9.5
G	Land/building rental	0	1	1	5	0	8.5
H	Machinery maintenance	0	0	0	0	0	0.0
I	Other	0	0	0	0	0	0.0
	Sum	8	9	7	8	4	59.9

Q6.3

	Rank	1	2	3	4	5	Wt avg
A	Shortage of recyclables	1	1	1	0	2	7.0
B	Recyclables contamination/poor quality	0	0	0	0	0	0.0
C	High land/building rental costs	0	0	1	1	0	2.5
D	Excessive transportation costs	1	0	3	0	2	6.0
E	Unstable demand	0	0	0	0	0	0.0
F	Utilities	2	1	0	1	0	6.0
G	Loss of market	0	1	0	2	0	4.0
H	Obtaining credit	1	3	1	0	0	10.0
I	Other	2	1	0	0	0	7.0
	Sum	6	6	5	4	2	39.5



		Percentages of total qty of recycables									Tot	Notes		
		H	Ht	Hp	C	M	S	GO	I	O				
	Pl	50.0	30.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	100			
	Poly	0.0	0.0	0.0	40.0	0.0	0.0	0.0	60.0	0.0	100			
	Bg	1.6	0.0	0.0	98.4	0.0	0.0	0.0	0.0	0.0	100			
	P/C	54.8	0.0	0.0	39.5	0.0	0.0	5.7	0.0	0.0	100			
	Br	55	7.5	0.0	34.6	0.0	0.0	0.0	0.9	1.6	100			
	Bot	54.8	17.8	0.0	18.5	0.0	0.0	0.0	4.9	4.1	100			
	Me	60.4	0.0	0.0	4.0	0.0	0.0	0.0	19.3	16.3	100			
	Ba	66.0	0.0	0.0	18.5	0.0	0.0	0.0	15.4	0.0	100			
											Within BMA			
Tot (kg)		Actual quantity from different sources											kg/mth	kg/d
4500	Pl	2250	1350	0	0	0	0	900	0	0	4500	1852	60.9	
1300	Poly	0	0	0	520	0	0	0	780	0	1300	535	17.6	
2825	Bg	45	0	0	2780	0	0	0	0	0	2825	1163	38.2	
15475	P/C	8475	0	0	6120	0	0	880	0	0	15475	6369	209.4	
12700	Br	7030	950	0	4400	0	0	0	120	200	12700	5227	171.8	
6501	Bot	3564	1155	0	1201	0	0	0	317	264	6501	2675	88.0	
27305	Me	16499	0	0	1090	0	0	0	5276	4440	27305	11237	369.4	
4920	Ba	3250	0	0	911	0	0	0	0	759	4920	2025	66.6	
75526	Tot	41113	3455	0	17022	0	0	880	7393	5663	75526	31082	1021.9	
Adjust Tot1		41113	3455	0	17022	0	0	880	7393	5663	75526			
Location factor		42	23	100	50	100	100	100	20	35	41			
Adjust Tot2		17453	777	0	8511	0	0	880	1479	1982	31082			
Qty	kg/d	574	26	0	280	0	0	29	49	65	1022			
Notes:	%	56.2	2.5	0.0	27.4	0.0	0.0	2.8	4.8	6.4	100.0			

- One bag weighs 0.1 kg
 - One bottle weighs 0.66 kg (avg weight of 10 beer and arrack bottles) - assume same source distribution for bottles and broken glass.
 - Adj1 - adjust total to a/c for a total of 8 middlemen in Badulla with all 8 being surveyed (i.e. no adjustment)
 - Adj2 - adjust Adj1 to a/c for 41 % of materials collected in BMA (assume applies to all categories)
- a. MMB3 (100% materials collected from outside BMA) and MMB4 (80% from outside) indicates:

	MMB3	MMB4	Total		Max inside qty
At least	3731	10860	14591	kg collected from households outside Badulla	26522 kg
At least	0	2565	2565	kg collected from hotels outside Badulla	890 kg
At least	708	6222	6930	kg collected from commercial enterprises outside Badulla	10092 kg
At least	4236	1326	5562	kg collected from industries outside Badulla	1831 kg
At least	750	2443	3193	kg collected from other places outside Badulla	2470 kg

Location factor %s also adjusted to take this into account

- Assume 100 % for Hp, M & S - no impact as qts from these sources are zero.
- Assume 100 % for GO - only pa/ca & rel. small qty - reasonable to assume comes from GOs in Badulla
- Assume 23 % for hotels (only plastic, broken glass & bottles) - suspect this answer includes guesthouses and some local hotels (i.e. cafes, restaurants) within Badulla also
- Assume 50 % for C - consistent with MMB3 and MMB4 data
- Assume 20 % for I - consistent with little industry within Badulla and MMB3+B4 data
- Assume 35 % for O - mainly garages & consistent with MMB3+B4 data
- Get household total by difference= 42 % or 17453 kg/mth

3.5 Other Information

Community Focus Group Discussion 1

Name of the Municipality:	Badulla- Municipal Council
Area name:	Katupelellagama.
Date & Time:	2002/10/02, 11:00 – 11:45
Precipitants:	<ol style="list-style-type: none">1. Ms. M. Oishi (JICA study team)2. Ms. Subhashini Seneviratne (JICA study team)3. Mr. Sugathadasa (UPASV)4. 2 male and 18 female of Katupelellagama, Badulla.

Opinions about present situation of garbage collection

1. Present collection system

No collection service for this area. However, they don't have any serious problems with regard to waste discharge. They have enough space for self disposal and use *Jeeva Kotu*, hedgerow, for making compost. Earlier they burnt their garbage and after introducing jeeva kotu, they don't burn their garbage except polythene and plastic.

2. Identified main problems

- No water facilities
- No permanent houses
- No toilet facilities
- No way to discharge dirty water around the school area

3. Proposed solutions / suggestions

Constructing a rain water storage tank

4. Other problems

In this area, people are poor and most of them earn their living by hired labour works. Women in this community have time to do some handcraft work, sewing, etc., but there is no one to teach them. They would like to be trained for some works which can earn some money while staying at home.

Community Focus Group Discussion 2

Name of the Municipality:	Badulla- Municipal Council
Area name:	Deyyannewela
Date & Time:	2002/10/03 2:30 – 3:00
Precipitants:	<ol style="list-style-type: none">1. Ms. M. Oishi (JICA study team)2. Ms. Subhashini Seneviratne (JICA study team)3. Mr. Nalin Gomez (CDO Badulla Municipal Council)4. Mr. Anura Marasinghe (CDO Badulla Municipal Council)5. One male and 7 female residents in Deyyannewela

Opinions about present situation of garbage collection

1. Present collection system

Garbage is collected from the nearest bin which is used by 30 to 35 households usually one in two weeks or sometimes one in three to four weeks.

2. Identified main problems

- The number of concrete bins is not enough at all.
- The collection frequency is too low.
- The drainage is very dirty and always it was choked up by kitchen waste dumped by people illegally.

3. Proposed solutions / suggestions

- Constructing two big dust bins in the area.
- Collection frequency should be at least 2 times per week.
- Drainage should be rehabilitated cleaned up at least once a month by municipal workers.
(Currently some residents clean it once in two weeks by themselves, but it is not enough)

4. Other problems

Road condition is very bad.

Poor quality and less frequency of the municipal garbage collection itself prove the unsanitary condition on the roads in this area, and residents are frustrated with the situation. Before asking community cooperation, first of all, the regular emptying of the community dust bin in this area should be carried out.

Organizational Information Sheet 1

Interview date : 2002/09/30

Name of the organization:	Uva Praja Arthika Sanvardene Viyapruthiya
Name of the chairperson:	Mr. M.Sugathadasa
Address and contact number:	42/1, Peelipatha Rd, Badulla Tel: 078-730629
Year of establishment:	1995.01.07

1. General information

- No. of personnel: 3 person voluntary basis (they get only a allowance, and they use 4 facilitators when they conduct)
- Fund resource: CEIF(Ministry of Environment through Community Environmental Initiative Fund) and personal money
- Working area: Badulla

2. Main activities

- Health and nutrition program
- Economic development (self employment)
- Environment program, such as jeeva kotu composting and preventing soil erosion

Other activities:

- Member of national community environment forum in Badulla district

3. Cooperation with other organizations

- Sanasa – Hindagoda, Badulla
- Women organization (Katupellella)
- Education development program
- Uva praja arthika viyapruthiya

Organizational Information Sheet 2

Interview date : 2002/10/04

Name of the organization:	Sanasa- Badulla, Hindagoda branch
Name of the chairperson:	Mr. R.M. Sirisena (Deputy Commissioner of EPB)
Address and contact number:	69/5B, Passara Road, Hindagoda, Badulla
Year of establishment:	1995.01.07

1. General information

- No. of personnel : 07 person voluntary basis (4 committee members and chairman, secretary and manager. Only manager gets a monthly payment They also use one facilitator when they conduct programs and pay an allowance for him) 65 members
- Fund resource: CEIF(Ministry of Environment through Community Environmental Initiative Fund)
- Working area: Badulla

2. Main activities

- Savings and credits
- Environment protection in upper Dunhinda oya area (self employment) and soil conservation
- Counseling and guidance
- Children clubs development

Other activities

- Member of national community environment forum in Badulla district

3. Cooperation with other organizations

- Uva praja arthika sanvardene viyapruthiya, Badulla
- Badulla district community environment forum
- MC Badulla

Activities of Divisional Environmental Officers

Interview date: 2002/09/23

Name of the Municipality:	Badulla Municipal Council
Name of the officer:	Mr. R. Jayasekara
Year of appointment:	1997
Address and contact number:	Badulla Municipal council, Badulla. 055- 22275

1. Organizational information (which department do you belong to in municipalities)

Central Environment Authority- He is responsible for the deputy director of education and training.
In the municipal council he is responsible for the municipal commissioner.

2. Main activities

- Establishment of environment committee and
- School education program, (environment pioneer brigade groups and eco clubs)
- Issuing environment protection licenses.
- Conducting lectures for women small groups in NGOs with regard to the environmental related program

2.1 School Program

There are 17 schools in Badulla city limit and only 12 schools are actively participating in the environment pioneer brigade program. The rest 5 schools are Tamil and Muslim, so he was unable to make program for these schools due to language problem.

Name of the school	No of Groups	Medals obtained
1. Viharamahadevi vidyalaya	1	1
2. Dharmadutha vidyalaya	1	
3. Dhammananda vidyalaya	1	3
4. Rathanapala vidyalaya	1	
5. Wijayaraja vidyalaya	1	1
6. Pinarawa vidyalaya	1	
7. Vishaka vidyalaya	1	1
8. Uva maha vidyalaya	1	1
9. Sujatha vidyalaya	1	
10. Rahula vidyalaya	1	1
11. Sirisumana vidyalaya	1	1
12. Badulla maha vidyalaya	1	1

Except Badulla maha vidyalaya, eco clubs have established in every other schools. District commissioner is in Bandarawela Kuda Kusum Vidyalaya and deputy commissioner is in Dhammananda vidyalaya Badulla. His name is Mr. R.M.Sirisena.

2.2 Environmental Committee

They have no environment committee in the Badulla municipal council. The reason is no enough space to establish an environment committee. But he is the acting environment officer of both district and divisional secretariat office. When they have meeting municipal commissioner and himself are participate in the meetings.

2.3 Other activities

Prepare arrangements for specific days such as world environment day, tree planting day, sramadana (cleaning activities) etc. Besides that he has to conduct and organize any activities which asked by the CEA and BMC with relevant to his subject.

When he conducts environment program or sramadana NGOs in Badulla area and school children of EPB groups are participate.

Following are the NGOs which he collaborate in environmental programs.

1. Uva praja institute
2. Uva development community institute
3. BRIT environment program
4. "Future in our hand" "Anagathaya apey athe"
5. women development foundation

Chapter 4

Badulla Pilot Projects

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Chapter 4 Badulla Pilot Project - Progress Diary

4.1 Strengthening the Managerial Capability

4.1.1 Amendment of By-law

The draft by-law was prepared in September and will be submitted to the Council in October for the approval.

4.1.2 SWM control board

- 1) MCB considers how to use the SWM control board. Information was included.
- 2) MCB prepares a map marking the locations and responsible zone of PHIs and supervisors.
- 3) MCB orders a SWM control board.

MCB has now fixed some difference in survey map (esp. including additional roads to the map).

- 4) JICA Study Team pays for it.

JICA study team paid 2/3 of the total production cost of the control board in advance on **2 July**.

- 5) MCB installs the control board in September in PHI's room and started to use it.

4.1.3 SWM manual

- 1) They haven't started to use the keeping data system by October.

4.1.4 Monthly report

- 1) Preparation of the monthly report hasn't started by October.

4.1.5 Training of management and supervision

- 1) 1st training was conducted on **1 July**. All 14 relevant officers (4PHIs, 5CHAs, 3supervisors, environmental officer) participated in the training seminar on "Introduction of solid waste management", "waste generation, composition, waste stream", "how to use SWM planning data" and hands-on group exercises such as making a schedule of waste collection, a discharging rule of garden waste and a simulation of using stationary trailers.
- 2) 2nd training was conducted on **21 July**. 12 relevant officers (4PHIs, 4CHAs, 2supervisors,

1 environmental officer) participated in the training seminar on “Management and role of supervision” which focused on understanding of organizational behavior, managing self and others, leadership, etc.

- 3) 3rd training was conducted on 5 Aug. relevant officers (4PHIs, 4CHAs, 2supervisors, 1 environmental officer) participated in the training seminar on
- 4) 4th training

4.1.6 Formulation of the long term plan

- 1) Commissioner prepared the short-term plan in August. The study team modified the long term plan prepared by Commissioner in September. The draft action plan was prepared and submitted to Commissioner in October for verification.

4.2 Waste Minimization

1) Formulation of waste minimization programme

- Assisting middlemen
- Jeewa Kotu
- Promotion of my bags

2) Implementation of the waste minimization programme

- **Promotion of Jeewa Kotu**

2 Community health assistants have done trial programs of promoting Jeewa Kotu for pre-school teachers and mothers, supported by the local NGO named Bio-diversity Research Institute and Training centre (BRIT). 2 model of Jeewa Kotu were fabricated at respective pre-schools and _____ mothers participated in the programmes. (19, 24, 25 July)

4.3 Waste Collection Improvement

4.3.1 Introduction of bell collection

1) Formulation of the Waste Rule

- Formulated a waste discharging and collection rule. (22 July)

- (Selection of the area for introducing bell collection with the publicity)

MCB has selected Badulpitiya area to introduce Bell collection system with the publicity. **(22 July)**

- Planning the waste collection days by area

MCB has prepared a colored map and a schedule table of 3 collection days a week in the area.

(Badulpitiya area was divided into two areas: one area on M,W,F collection, the other on T,T,S)

(24 July)

2) Publicity of the Rule

- To inform the collection days and the discharge rule to citizens.

✓ MCB produced 3 banners for the publicity and placed them at MC, bus stand and center of the town. **(26 July)**

✓ MCB/JICA has printed 6,000 **leaflets** to inform the discharging rule and the bell collection to the citizens. **(25 July)**

✓ At the same time, MCB has printed 500 **leaflets** to inform the collection days at each street of Badulpitiya area. **(25 July)**

✓ In Badulpitiya, prior to the trial operation of bell collection, PHIs and CHAs distributed about 600 of both leaflets, while one CHA went around the streets by the UNICEF truck with **loudspeakers** announcing to the public about waste discharging rule and the new collection system. **(26, 28 July)**

- on-site education
- notice boards
- educational center

- To teach how to do the bell collection to staff in MCB

- To teach the rule to municipal council members (Environmental committee)

MCB/JICA held an awareness program on municipal council members to explain the pilot project, especially how to introduce the bell collection system. **(11 July)**

3) Preparation of the Implementation

- Fixing amplifier and speaker set onto tractors.

Speaker/amplifier units were fitted to 2 wheel tractor (Kubota) for Badulpitiya and 4 wheel tractor for other collection areas.

- To teach drivers and labourers how to do the bell collection

PHIs conducted an educational program to introduce waste collection improvement by the pilot project and taught them how to do the bell collection. (26 July)

- Trial operation to be attended by PHI and CDAs

MCB implemented a trial operation of bell collection system on 29 July. All PHIs and CDAs attended and instructed a driver and labourers in charge of Badulpitiya.

- MCB extended the bell collection area by area and finally reached the bell collection to cover the whole area in 1st November.

4.3.2 Stationary trailer, modified handcarts, litter bins and plastic buckets

- 1) Modification of equipment and materials
- 2) Order the fabrication and supply of equipment and materials

30 % of total production cost was paid by JICA study team. (4 July)

- 3) Procurement of equipment and materials

- ✓ Fabrication of fixed/removal litter bins completed on 21st Aug.
- ✓ Stationary trailer: some parts have been prepared in Colombo, and some raw material was delivered from Colombo as of 29 July.

- 4) Preparation for the installation (locations, responsibility system etc.)
- 5) Educating shopping complex traders and hotel owners
- 6) Installing of stationary trailers, litter bins and plastic buckets

4.4 Environmental Education

- 1) Procurement of equipment (11 July)

2) Establishment of the security and O & M system for equipment (8 July)

All equipment is placed at the commissioner's room for security before completion of refurbishing education center.

3) Preparation of yearly education programme

4) Training of equipment utilization (14 July)

5) Training of education material production

6) Refurbishing the environmental education center completed by 21st Aug.

7) On site education

MCB conducted 1 school program and 1 pre-school program for health and environmental education during local government week. (15, 18 July)

8) Operation of the EEC

EEC was inaugurated on 22nd August. They started to use it and more than 20 lectures on environmental protection was conducted there by November.

4.5 SWM project cost and details for Badulla MC Project

4.5.1 Location of Bandarapura Landfill Site

The project site is located in HINURUKADUWA Division, Glen Aplin Estate – Balanyada plantation Ltd. The site is 4 km away from Budulla Town center.

The site catchments area is belong to Baduluoya River which flow 2 km away from the site.

The site is surrounded by Badulla Industrial park and the tea plantations. Most part of the candidate area is covered by tea plantations that established 30-40 years ago.

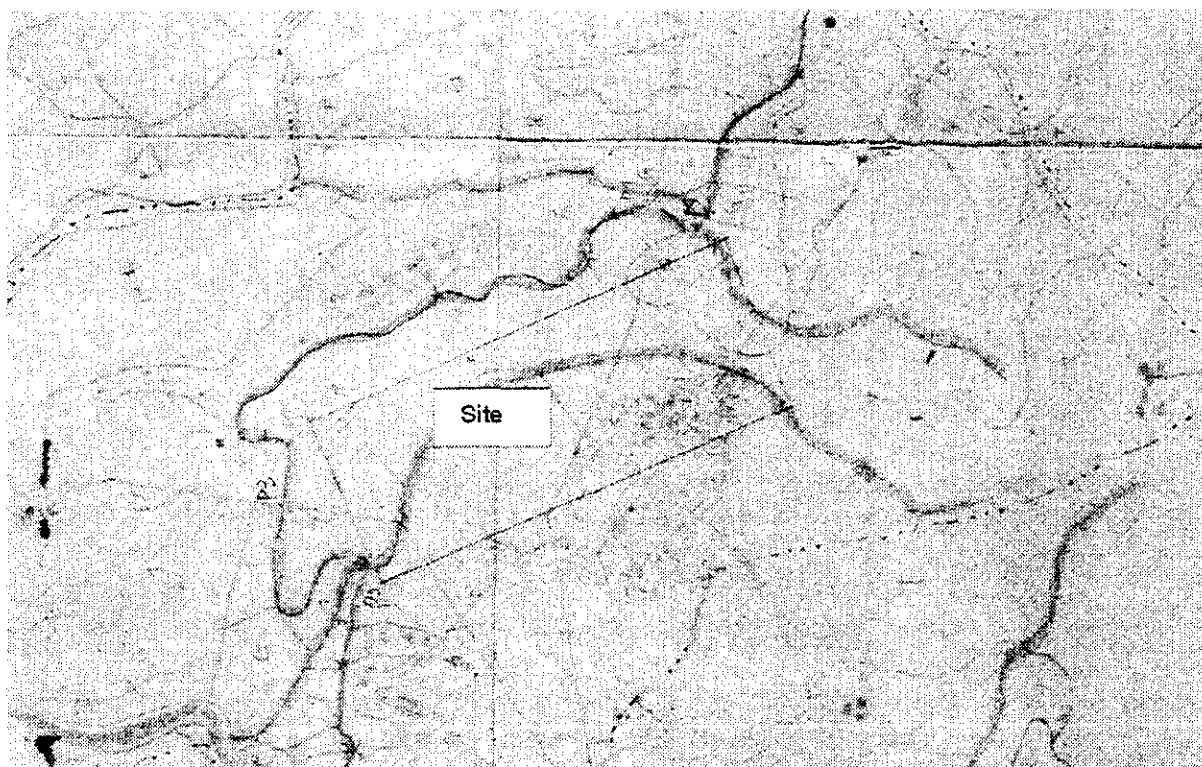


Figure 4-1: Location of Bandarapura Landfill Site

4.5.2 Sanitary Landfill Facility for Bandarapura Landfill Site

Table 4-1 and Figure 4-2 show the conceptual design of the Bandarapura Landfill Site. The extent capacity is designed as 125,000m³, while the life span of Bandarapura landfill site is estimated as approximately 12 years.

Table 4-1: Conceptual Design of improved Bandarapura Landfill Site

Item		unit	Qty
Total area of landfill		ha	1.55ha
Extent Capacity		m ³	125,000
Type of landfill method		-	Semi-Aerobic
Administration	Control office	no.	1
	Garage for bulldozer	no.	1
Security and safety facility	Gate	no.	1
	Fence (Fixed type)	Length	534m
Sanitary waste disposal facility	Access road (asphalt paved) for long term use	Length	555m
	Access road (gravel) for short term use	length	119m
	Fence (Movable type)	L.S.	1

Leachate collection facility	Main leachate collection pipe	Length	300m
	Leachate collection branch pipe	Length	413m
Leachate treatment facility	Earth Fill embankment	no.	1
	Circulation pump	no.	1
	Circulation pipe	L.S.	1
Gully sucker treatment facility		no	1
Storm water drainage	Rip rap type along the waste filling slope	Length	310m
	Earth drain type along the road	Length	555m
	Storm Water Drainage	Length	380m
Gas ventilation facility – Perforated oil barrel filled with rubble stone		nos.	7

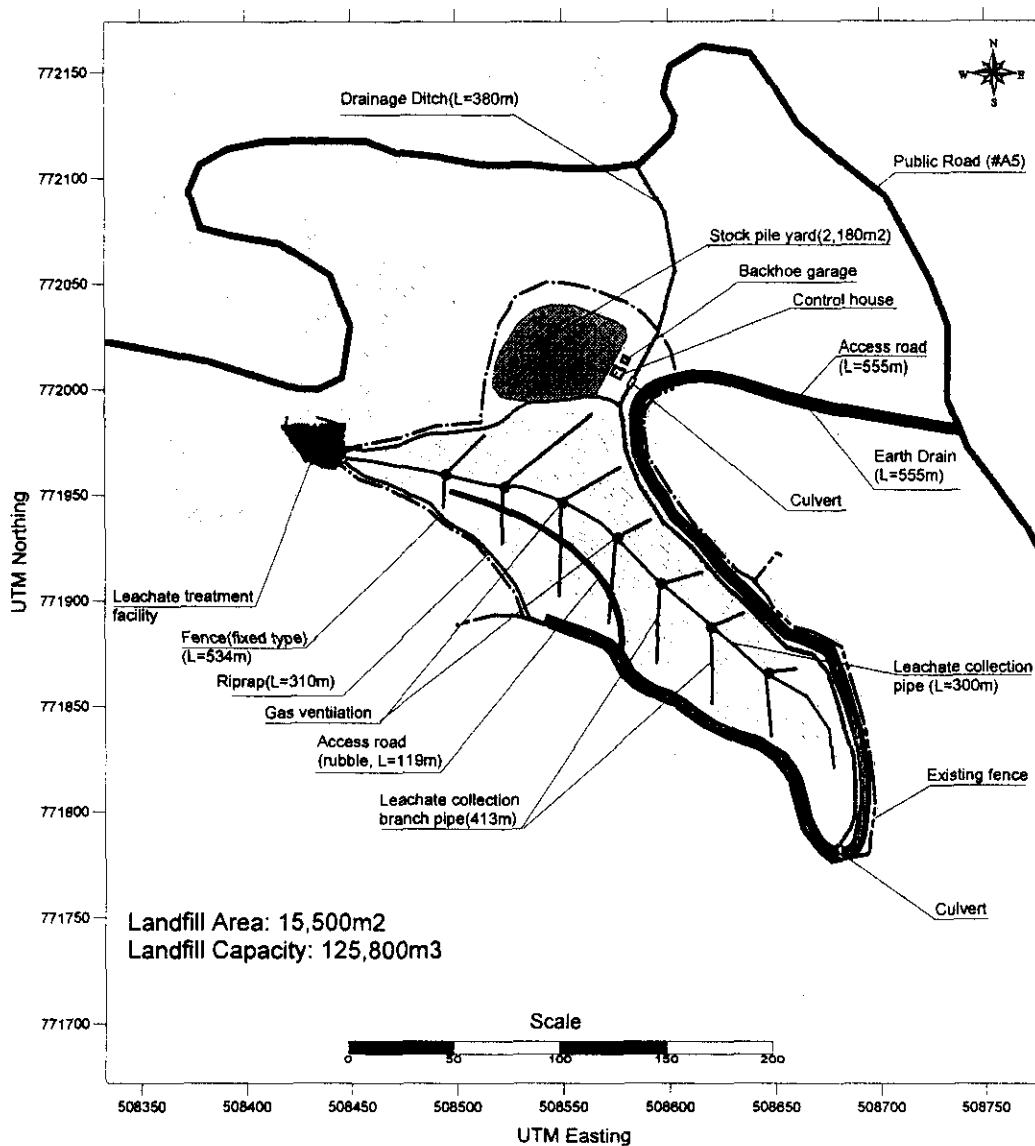


Figure 4-2: Facility plan for Bandarapura Landfill Site

4.5.3 Main Facilities detail

4.5.3.1 Leachate Collection System

In order to avoid the contamination of ground water by leachate, all leachate which generated from landfill operation shall be collected by leachate collection system and introduced into the leachate treatment facility. The leachate collection system generally consists of the following components.

- Low permeable bottom liner
- Leachate collection pipe network

a. Low permeability of bottom layer

The low permeability is required at bottom layer. It shall be protected for infiltration of leachate to groundwater. In case bottom layer could not complied with the requirement, artificial liner shall be used to preventing contamination of groundwater. However, the provision of artificial liner cost is always having high proportion in the construction cost. In order to save the cost, we recommended fully utilize of the natural condition instate of using artificial liner.

b. Leachate collection pipe network

The leachate collection pipe network shall be installed to achieve the following purposes.

- 1) To collect and introduce leachate to the leachate treatment facility.
- 2) To naturally supply fresh air into the inside of landfill to accelerate the waste decomposition process.

Net work of leachate collection system is shown in Figure 4-2 and sectional detail is shown in Figure 4-3 and Figure 4-4.

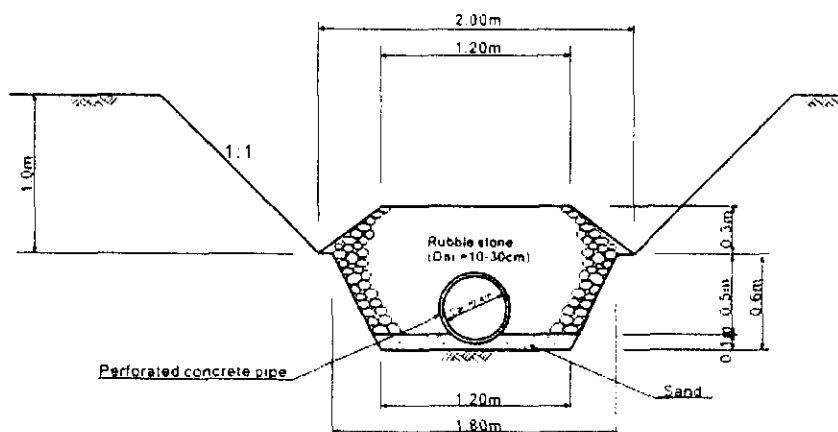


Figure 4-3: Section of Main Leachate Collection Pipe

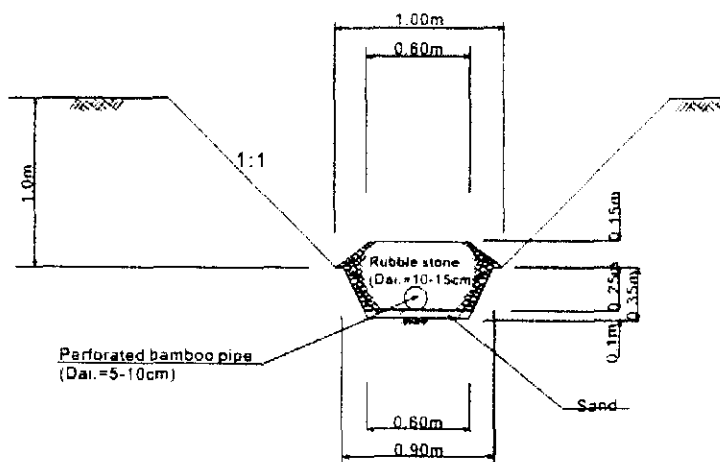


Figure 4-4: Section of Leachate Collection Branch Pipe.

c. Leachate Treatment process

The selection of leachate treatment system shall be very important in the project planning. Because there are many kind of systems and they have different merits. The following three points are main criteria for the selection of the system.

- Required sufficient structure's area
- Required technical skill for the operation
- Needed operation and maintenance cost

Study team proposed recirculation system for Badulla project.

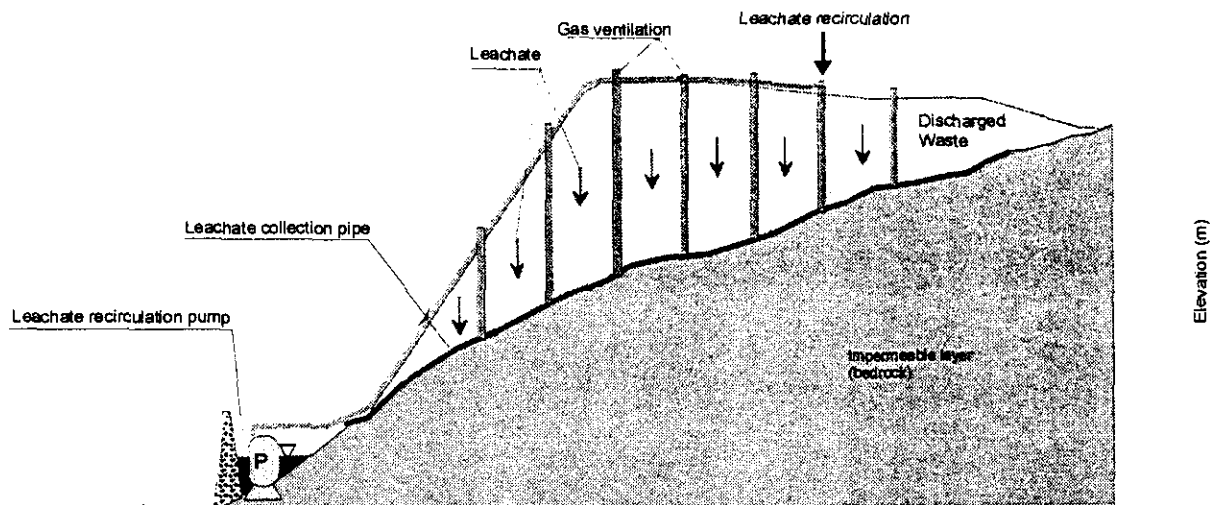


Figure 4-5: Sketch of Leachate Treatment Facility

d. Gas Ventilating Facility

The gas ventilating facility shall be provided for the following purposes.

- 1) Exhaust landfill gas generated by the landfilled waste to minimize the risk of gas explosion
- 2) Acceleration of waste decomposition process with supplying fresh air into the landfill waste through gas ventilating facility (semi-aerobic type)

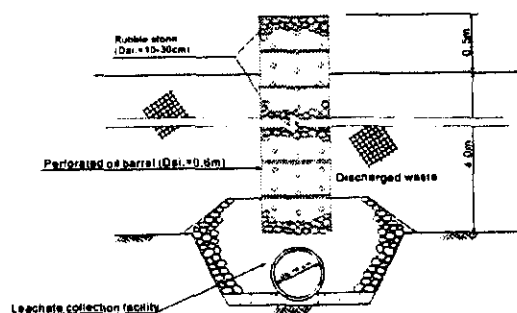


Figure 4-6: Gas Venting Facility

e. Storm water Drain

The storm water drain shall be installed for the following purposes.

- 1) Minimize creation of the amount of contaminated water.

- 2) To avoid any damage against to access road.
- 3) Provision of a guide for the landfill slope gradient.

The earth drain shall be provided along the access road to collection of rainfall water which came from forest.

Riprap lined drain shall be provided along the slope of the waste filling area.

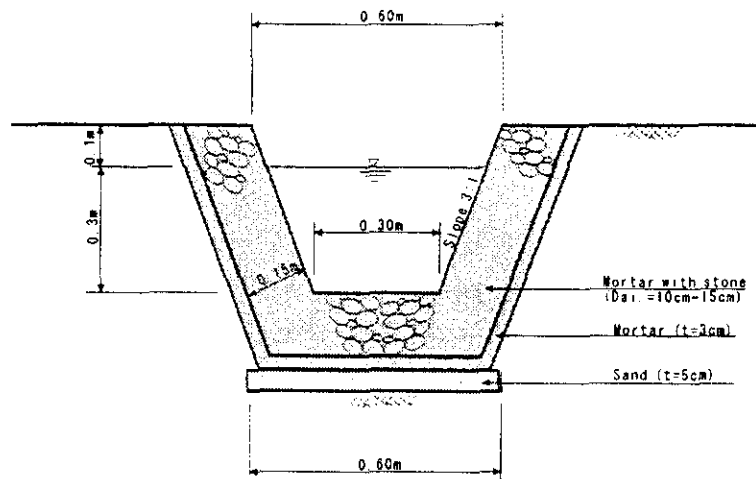


Figure 4-7: Riprap Lined Storm water Drain

4.5.3.2 Details of other structure

a. Bench (terrace)

The purpose of bench is as follows.

1. To protect the slope by cut off of runoff water flowing on the slope.
2. To provide the enough space for the stabilisation of slope.
3. To provide the enough working space for the slope maintenance.

The bench plan is as follows.

- Every 5 meters in height.
- 2 meters in bench width.

b. Turfing

The outside of slope of the waste filling will be covered by turf for the following purposes.

- 1) Protection of the slope from erosion by runoff water.
- 2) Maintenance of the good view.

c. Fence (movable type)

The movable fence will be placed for prevention of waste scattered to outside of the site where necessary.

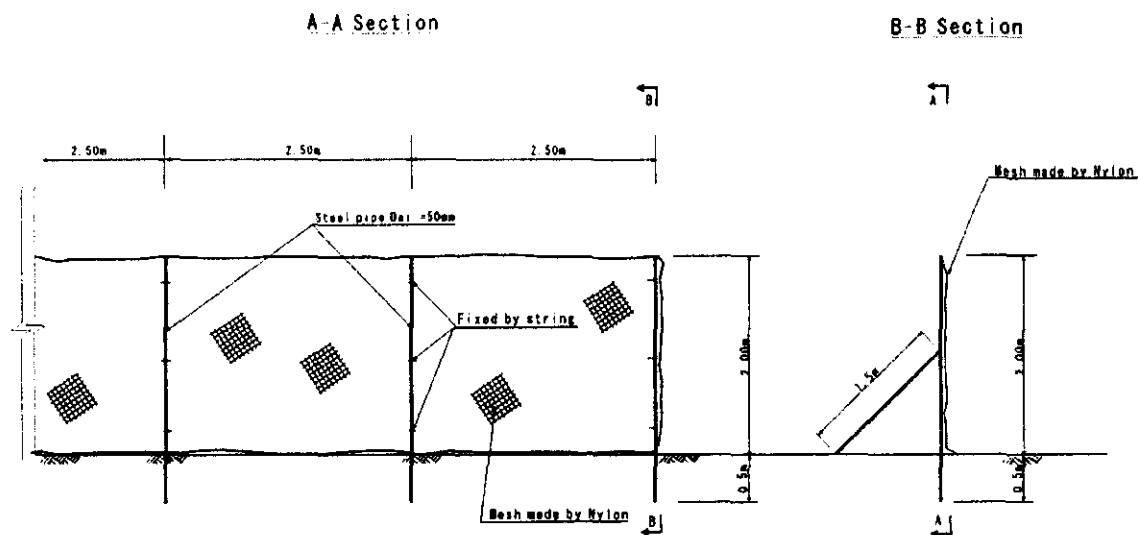


Figure 4-8: Fence (movable type)

d. Disposal Pit for Healthcare Waste

The disposal pit for healthcare waste will be constructed separately. It receives the following wastes which required with special care for handling.

- Syringes
- Medical tools and goods which contacted blood

The disposal pit shall be completely closed by a fence to ensure nobody enter into the disposal pit except the landfill staff.

In order to avoid the leachate generation from healthcare waste, the following facilities shall be installed to avoid the entry of runoff water into the pit.

- 1) A roof to cover the whole disposal pit

2) Drain surrounding the whole disposal pit to collect the runoff water.

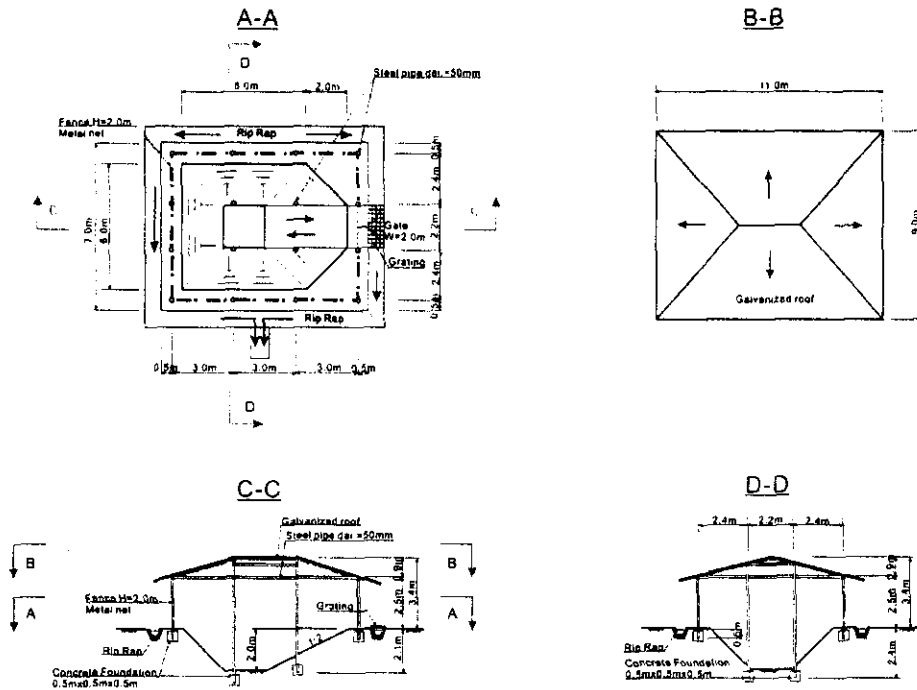


Figure 4-9: Disposal Pit for Healthcare Waste

e. Administrative Facilities

1. A site office will be built to provide a proper space for administrative work, rest space, and sanitary facility for employees in the landfill site.
2. A store house will be built to keep tools, materials, safety goods, etc.
3. A garage for a bulldozer will be built to secure and to maintain a bulldozer.

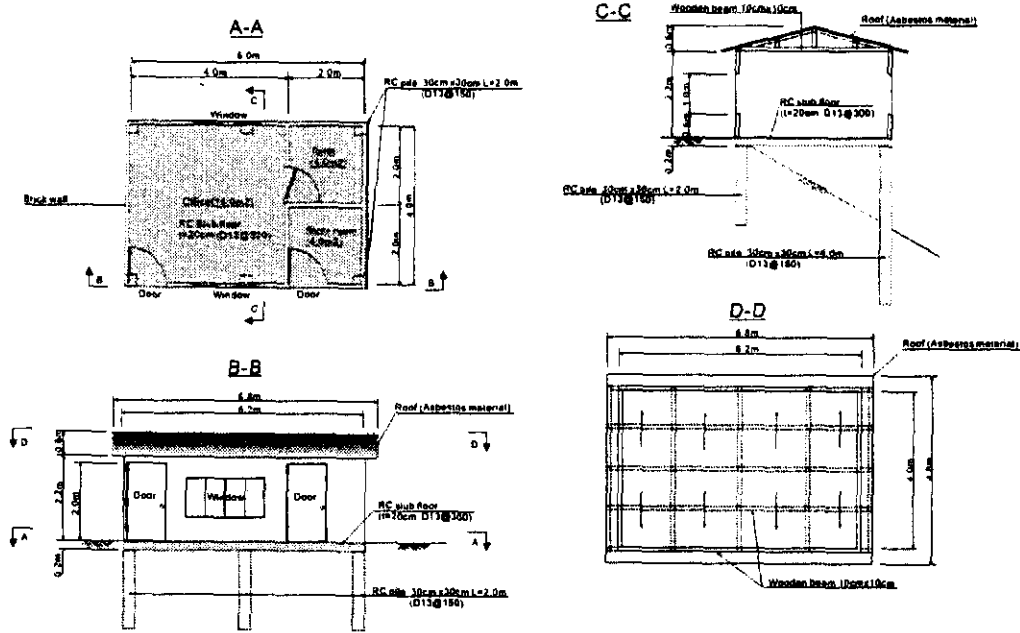


Figure 4-10: Administrative Facilities

f. Security facilities

A gate and fences shall be installed to control of the entry. Fence will function as the waste scattering net as well.

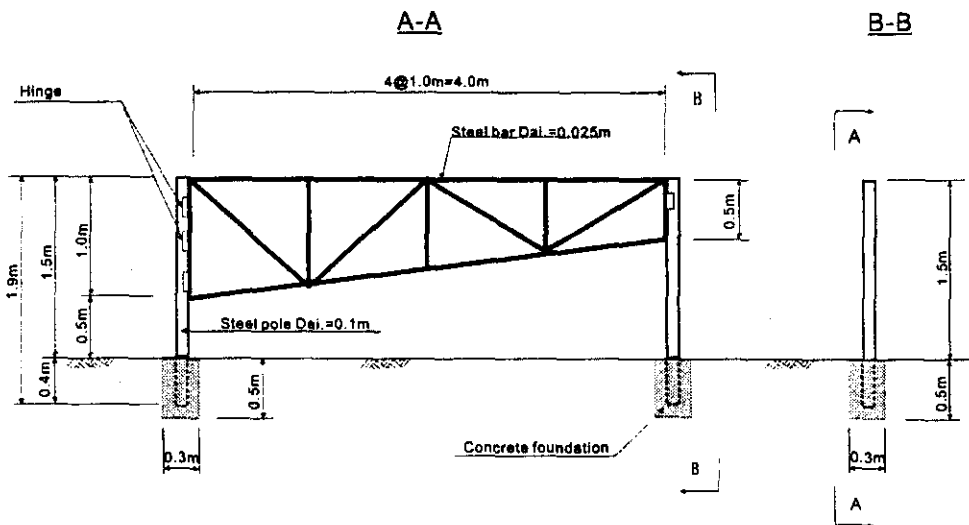


Figure 4-11: Gate

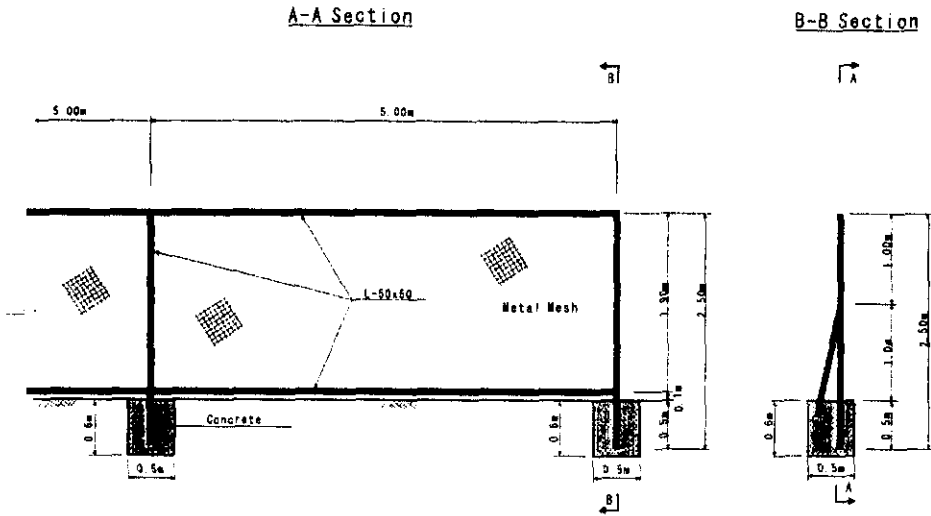


Figure 4-12: Fence (fixed type)

g. Access road

Maintain of access road is very important for landfill site operation, a lot of waste collection vehicles will be access to disposal area even on rainy days. The provision of good access road is essential to ensure the good waste collection efficiency. In addition, good access road will help to prolong the life time of waste collection vehicles and to reduce the repairing cost.

The following two types of access roads shall be provided.

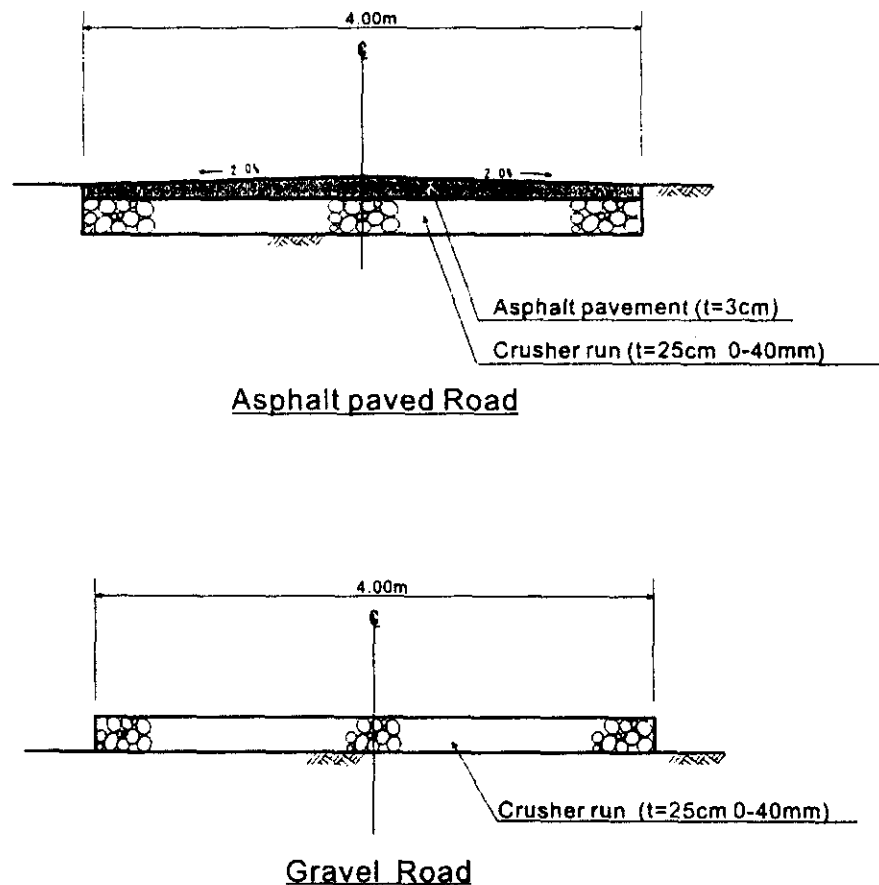


Figure 4-13: Typical Cross Section of Access Road

h. Improvement of existing drainage system

The condition of ground surface will be changed due to the construction of proposed landfill site. The existing pipe culvert is required to be up-grade. However up-grade design has carried out based on existing land utilisation plus proposed landfill site, therefore in case of changing of land utilisation in industrial park which located beside of proposed landfill site or development of forest area which located upper stream of proposed landfill site, drainage design shall be reconsidered.

Based on proposed landfill site design, it has minimised changing of land utilisations, therefore up-grading works is required only pipe culvert. However when large scale of development will plan, it may require up-grading of drainage system (ex. retention pond at the down stream.)

4.5.4 Initial Investment Cost and O&M cost of Bandarapura Landfill Site

4.5.4.1 Initial investment cost of Bandarapura Landfill Site

Based on facility plan of improved Bandarapura landfill, initial investment cost is summarised in

Table 4-2.

Table 4-2: Initial Investment Cost of Bandarapura Landfill Site

Description	Unit	Q'ty	Rate	Amount (Rs)	
Pre-Construction Cost					
Soil investigation Fees	Soil strata, Permeability	Ls	1.00	369,600	
Land Survey	Topography, Sectional	ha	1.80	61,600	
Detail Design Fees	Structure Design	5% of Construction cost	Ls	1.00	446,000
Application Fees for Authorities		Ls	1.00	100,000	
Purchasing of Bulldozer	D4 class	Ls	1.00	6,800,000	
Sub Total		ton	89,000	87.94	
Construction Cost					
Site Clearing, Logging Tree		ha	1.80	100,000	
Administration	Control office	no	1	1,450,000	
	Garage for Bulldozer	no	1	1,080,000	
Security and safety facility	Fence	Fixed	m	534	1,600
	Gate		no	1	17,900
Sanitary waste disposal facility	Access road	Gravel	m	119	860
		Asphalt Pavement	m	555	1,400
Leachate Collection Facilities	Main Line		m	300	1,600
	Branch Line		m	413	1,600
	Correction pond (V=150m3)	Earth fill & cut	m3	500	30
Leachate treatment facility	Circulation pump	Head 20m	no	3	284,600
	Electricity wiring		Ls	1	500,000
	Circulation pipe		m	240	600
Gully sucker treatment facility	Gully suck treatment facility		no	1	650,000
	Pit		no	2	60,000
	Sedimentation tank		no	1	90,000
	Fence & Gate		m	70	2,000
	Storm Water Drainage		m	35	260
Gas Vertical Ventilation	Dia 600 mm		m	21	1,200
	Earth Drain		m	555	65
Storm water drainage	Pipe Culvert		m	20	15,000
	Rip rap type		m	690	430
Improvement of Existing Drainage	Pipe Culvert	Dia 1000mm	m	20	7,000
Sub Total		ton	89,000	100.25	
Total		ton	89,000	188.19	

4.5.4.2 Operation and Maintenance Cost of Bandarapura Landfill Site

Operation and maintenance cost is summarised in Table 4-3.

Table 4-3: Operation and maintenance Cost of Bandarapura Landfill Site

Description		Unit	Qty	Rate	Amount (Rs)	
Operational cost						
Supervisor	On / off	50% of salary	m'th	144.00	12,500	1,800,000
Bulldozer operator	Full time		m'th	144.00	18,000	2,592,000
Mechanic	Maintenance for Pump	50% of salary	m'th	144.00	7,500	1,080,000
Foreman	Full time		m'th	144.00	18,000	2,592,000
Security Guard & recorder	Full time		m'th	144.00	10,000	1,440,000
General Labour	3 persons		m'th	432.00	10,000	4,320,000
Sub Total			ton	89,000	155.33	13,824,000
Maintenance Cost						
Material Cost						
Covered soil	Imported soil		m3	25,000	185	4,625,000
Turfing	Closed turfing on the slope		m2	7,000	150	1,050,000
Gas Vertical Ventilation	Extension		m	194.00	1,200	232,800
Miscellaneous			Ls	1		400,000
Machinery Cost						
Excavator	Loading of stockpile	JCB (10 days/m'th)	m'th	144.00	115,200	16,588,800
Lorry	Transport of stockpile	4 ton (10 days/m'th)	m'th	144.00	72,000	10,368,000
Fuel and Oil etc	for Bulldozer		m'th	144.00	45,000	6,480,000
Spare parts and repairing	for Bulldozer	5% of M. Value	year	12.00	340,000	4,080,000
Others						
Electricity consumption			m'th	144.00	10,000	1,440,000
Sub Total			ton	89,000	508.59	45,264,600
Total			ton	89,000	663.92	59,088,600
			Year	12	4,924,050	59,088,600

Initial Investment		ton	89,000	184.30	16,402,395
Operational and Maintenance		ton	89,000	663.92	59,088,600
Grand Total	Per tonnage	ton	89,000	848.21	75,490,995
	Per Year	Year	12	6,290,916	75,490,995

4.5.5 Recommendations

Based on prototype SWM project, Bandarapura project is categorised in medium sanitary landfill which cost range about 350Rs/ton to 700Rs/ton. However the said project is exceeded of such a cost range. The main reason is the site will not secure adequate amount of soil within site area, therefore it required to import a lot of soil from out side. Its cost makes up 50% of O&M cost. Accordingly it may need to consider change of project location and/or consider alternative method of SWM project.

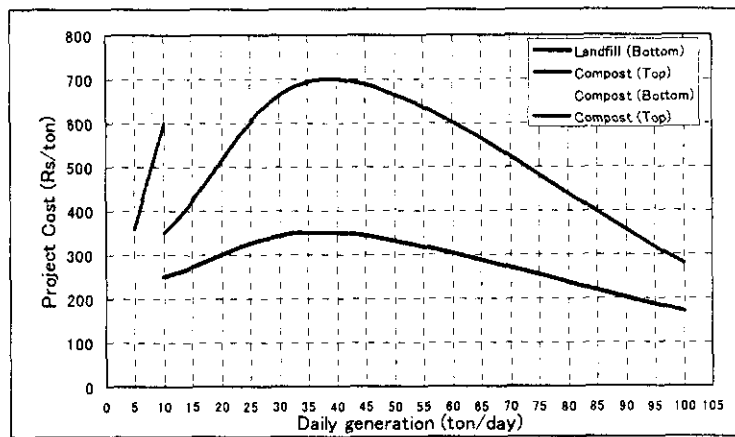


Figure 4-14: Project cost range

As mentioned earlier the compost plant is also one of the SWM project and its cost range about 260 Rs/ton to 360 Rs/ton (Windrow composting system). The study team recommend adopting the both methods (sanitary landfill and compost method). The concept is following;

- 1) Daily waste carrying in compost plant → To make compost → Generation of residue dispose to landfill site → Filling of residues are covering by compost instate of soil.

Advantages of the said system as below

1. Reducing of carrying in amount of waste to sanitary landfill site.
2. Keep longer life time for sanitary landfill site.
3. No need to purchase of covering soil.
4. Not need to purchase heavy machinery (Rental machinery when needed)

Additional cost will be required for compost plant (Say 260~360Rs/ton). However the combination system may reduce 50% of maintenance cost for proposed sanitary landfill. The total cost would be same or down scale of proposed landfill project cost. Furthermore life time of landfill site would be prolonging about 3 years from proposed project life time. Estimated cost as follow;

Table 4-4: Estimated cost for combination system

Initial Investments

Description		Unit	Qty	Rate	Amount (Rs)	
Pre-Construction Cost						
Soil investigation Fees	Soil strata, Permeability	Ls	1.00	369,600	369,600	
Land Survey	Topography, Sectional	ha	1.80	61,600	110,880	
Detail Design Fees	Structure Design	Ls	1.00	365,000	365,000	
Application Fees for Authorities		Ls	1.00	100,000	100,000	
Sub Total		ton	89,000	10.62	945,480	
Construction Cost						
Site Clearing		ha	1.80	100,000	180,000	
Administration	Control office	no	1	1,450,000	1,450,000	
Security and safety facility	Fence	Fixed	m	534	1,600	854,400
	Gate		no	1	17,900	17,900
Sanitary waste disposal facility	Access road	Gravel	m	119	860	102,340
		Asphalt Pavement	m	555	1,400	777,000
Leachate Collection Facilities	Main Line	Dia 200mm	m	300	1,000	300,000
	Branch Line	Dia 100mm	m	413	800	330,400
	Correction pond (V=150m ³)	Earth fill & cut	m ³	500	30	15,000
Leachate treatment facility	Circulation pump	Head 20m	no	3	284,600	853,800
	Electricity wiring		Ls	1	500,000	500,000
	Circulation pipe		m	240	600	144,000
Gully sucker treatment facility	Gully suck treatment facility		no	1	650,000	650,000
	Pit		no	2	60,000	120,000
	Sedimentation tank		no	1	90,000	90,000
	Fence & Gate		m	70	2,000	140,000
Storm water drainage	Storm Water Drainage		m	35	260	9,100
		Earth Drain	m	555	65	36,075
		Pipe Culvert	m	20	15,000	300,000
Improvement of Existing Drainage	Pipe Culvert	Rip rap type	m	690	430	296,700
		Dia 1000mm	m	20	7,000	140,000
Sub Total		ton	89,000	82.10	7,306,715	
Total		ton	89,000	92.72	8,252,195	

Operation and Maintenance Cost

Description		Unit	Qty	Rate	Amount (Rs)	
Operational cost						
Supervisor	On / off	25% of salary	m'th	180.00	6,250	1,125,000
Mechanic	Maintenance for Pump	25% of salary	m'th	180.00	3,750	675,000
Foreman	On / off	50% of salary	m'th	180.00	9,000	1,620,000
Security Guard & recorder	Full time		m'th	180.00	10,000	1,800,000
General Labour	2 persons	60% of salary	m'th	360.00	6,000	2,160,000
Sub Total		ton	89,000	82.92	7,380,000	
Maintenance Cost						
Material Cost						
Turfing	Closed turfing on the slope		m ²	7,000	150	1,050,000
Miscellaneous			Ls	1		400,000
Machinery Cost						
Excavator	Laying of Compost	JCB (10 days/m'th)	m'th	180.00	115,200	20,736,000
Others						
Electricity consumption			m'th	180.00	10,000	1,800,000
Sub Total		ton	89,000	269.51	23,986,000	
Total		ton	89,000	352.43	31,366,000	
		Year	15	2,091,067	31,366,000	

Sanitary Landfill					
Initial Investment		ton	89,000	92.72	8,252,195
Operational and Maintenance		ton	89,000	352.43	31,366,000
Total of Sanitary Landfill		ton	89,000	445.15	39,618,195
Compost Plant		ton	89,000	300.00	26,700,000
Grand Total	Per tonnage	ton	89,000	745.15	66,318,195
	Per Year	Year	15	4,421,213	66,318,195

4.6 Geological Survey for The Study on Improvement of Solid Waste Management at Badulla

GEOTECHNICAL SURVEY FOR THE STUDY ON IMPROVEMENT OF SOLID WASTE MANAGEMENT AT BADULLA.

Site Location : Part of Glen Alpine Tea Estate

Client: Kokusai Kogyo Co. Ltd

September 2003

**GEOTECH LIMITED,
No. 13/1, Pepillyana Mawatha,
Koluwala, Nugegoda, Sri Lanka.
Tel: 2813805, 071 2 735745 TEL/FAX: 2823881
E-Mail: geotech@euroka.lk
Web: www.geotechlanka.com**

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2. SITE DESCRIPTION
3. FIELD INVESTIGATIONS
4. SUB-SURFACE CONDITIONS
5. ANALYSIS OF PERMEABILITY TEST RESULTS
6. LABORATORY INVESTIGATIONS

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| Figure | 2 – Locations of Boreholes and Test area |
| Appendix | 1 - Borehole Logs |
| Appendix | 2 - Permeability Test Results |
| Appendix | 3 - Summary of Analysis of Permeability Test Results |
| Appendix | 4 - Laboratory Test Results |

GEOLOGICAL SURVEY FOR THE STUDY ON IMPROVEMENT OF SOLID WASTE MANAGEMENT AT BADULLA

1. INTRODUCTION

Kokusai Kogyo Co. Ltd. (hereafter referred to as the Client) has undertaken a study on Improvement of Solid Waste Management in Secondary Cities in Sri Lanka. One of the cities being investigated is Badulla.

The site to be investigated is about 2 km from Badulla Town and close to the Badulla-Passara Road. It is part of the Glen Alpine Tea Estate, and is situated in the valley below the Industrial Estate, (which is fenced off), and below the estate road. These features are shown in Fig. 1.

Geotech Ltd. was contracted by the Client to carry out a soil investigation for ascertaining the geological data necessary for designing overall development plans of the disposal site.

The scope of work was identified as:

- (i) to advance 14 boreholes up to rock or a maximum depth of 10 m in the overburden. These locations are shown in Fig. 1;
- (ii) to obtain disturbed samples from the overburden for visual classification;
- (iii) to establish the underground water table as measured from the water levels in the boreholes;
- (iv) to carry out field permeability tests in the boreholes;
- (v) to carry out laboratory tests on some of the soils near the surface;
- (vi) to prepare sub-surface profiles of the site using the borehole data.

2. SITE DESCRIPTION

A contour plan of the area is shown in Fig.1. The site elevations vary between 710 m and 750 m. The stream located in the valley was dry at the time of investigation, but is flowing during the rainy season. The land is part of a tea plantation where quartz rocks and boulders are found in abundance at the surface.

Referring to Fig.2, rock outcrops are visible on the eastern slope of the valley. Quartz rock outcrops are observed on the slope close to BH-12; and again above the road near BH-07. Rock is again exposed on the cutting done for the road near BH-06. Rock outcrops were not visible on the western slope.

3. FIELD INVESTIGATIONS

3.1 The Borehole Investigation consisted of advancing fourteen boreholes at locations marked BH-01 to BH-14 in Fig.1. The boreholes were advanced with a rotary drilling machine using overburden cutting tools and adopting the wash boring process to remove the cuttings from the bottom of the borehole. The boreholes, which had a diameter of 75 mm were supported with casing.

Borehole BH-14 was terminated before reaching basement rock at a depth of 10.0 m:

The other boreholes were terminated on reaching hard rock at the depths indicated below.

Location	BH-01	BH-02	BH-03	BH-04	BH-05	BH-06	BH-07
Depth (m)	6.25	9.55	7.0	5.6	2.1	0.75	2.3

Location	BH-08	BH-09	BH-10	BH-11	BH-12	BH-13
Depth (m)	1.3	2.5	4.3	4.8	0.85	1.2

Standard Penetration Tests (SPT's) were carried out regularly in the overburden. This test was carried out as specified in BS 1377.

Disturbed samples of soil were collected both from the SPT tube and the cuttings collected from the washings.

Ground Water Level (GWL) was encountered only in BH-02 and BH-14. It was determined as the depth at which the water level stabilized inside the borehole. The depth to GWL corresponded to 1.5 m and 2.45 m respectively in BH-02 and BH-14.

The results of the Borehole Investigations are given in Appendix 1.

3.2 A total of 14 Nos. Constant head field permeability tests were carried out in the boreholes at the depth indicated in the table below.

Borehole No.	BH-01	BH-01	BH-02	BH-02	BH-03	BH-03	BH-04
Depth of test (m)	2.0	5.25	2.0	8.55	2.5	6.0	2.5

Borehole No.	BH-05	BH-07	BH-08	BH-09	BH-10	BH-11	BH-13
Depth of test (m)	1.1	1.3	0.3	1.5	2.0	3.8	0.2

Borehole No.	BH-14	BH-14
Depth of test (m)	2.0	9.0

In this test, the hole of diameter 2 7/8 inches was initially cased to the bottom. The casing tube was then raised to a height of 1.0 m above ground level. The test was carried out with the casing kept full of water. Measurements were made of the amount of water introduced into the casing at 5 minute intervals, until a constant rate of water absorption was achieved.

The results of the Permeability tests are given in Appendix 2.

The field investigations were carried out from 16th to 25th August 2003.

4. SUB-SURFACE CONDITIONS

Using the results of the Borehole Investigation, profiles of the sub-surface conditions across the boreholes have been constructed and these are shown as

- Fig. 3a along the stream. These correspond to boreholes BH-13, BH-11, BH-08, BH-05, BH-02 and BH-14; and
- Figs. 3b, 3c, 3d and 3e perpendicular to the stream.

These figures correspond to the following cross-sections:

- o Fig. 3b across BH-10, BH-11 and BH-12;
- o Fig. 3c across BH-09, BH-08 and BH-07;
- o Fig. 3d across BH-04, BH-05 and BH-06; and
- o Fig. 3e across BH-03, BH-02 and BH-01.

These results show that,

- (i) ground water level (GWL) was encountered only at BH-02 and BH-14 at depths of 1.5 m and 2.45 from the surface respectively;
- (ii) the overburden consists of a residual formation of sandy clays, clayey sands, etc. followed by the stronger layer of very highly weathered rock. Corestones consisting of unweathered rock were found in some of the boreholes lying within the matrix of residual material;
- (iii) the depth to basement rock was small. It was close to the surface at several locations, and exceeded 10.0m only at borehole location BH-14.

5. ANALYSIS OF PERMEABILITY TEST RESULTS

The results of the Constant Head field permeability test are given in Appendix 2.

In the borehole permeability test, the coefficient of permeability (k) is given by

$$k = q / (F/H_c)$$

where q = constant rate of water intake

F = Intake Factor

H_c = Head causing flow

For the borehole cased to the bottom, $F = \frac{2 \times \text{diameter of hole}}{4}$

Specimen calculation for BH-14 at depth 9.0 m

Diameter of hole = 0.0762 m

F = 1.922 m

Depth to GWL = 2.45 m

$H_c = (2.45 + 1.0) = 3.45 \text{ m} = 345 \text{ cm}$

From figure of Total Intake vs. Time,
 $q = 26.2 \text{ cm}^3/\text{min.}$

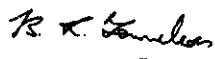
$k = 3.951 \times 10^{-4} \text{ cm/min.}$
 $= 6.585 \times 10^{-6} \text{ cm/sec}$

Rate of water absorption = $109.4 \text{ cm}^3/\text{min. per sq. m.}$

The summary of the results is given in Appendix 3.

6. LABORATORY INVESTIGATIONS

Laboratory tests were carried out on soil samples obtained from close to the surface at three location areas indicated in Fig.2. These results are given in Appendix 4.



Prof. B. L. Tennekoon
University of Moratuwa



L.P. Jayasinghe
Geotech Limited

15th September 2003

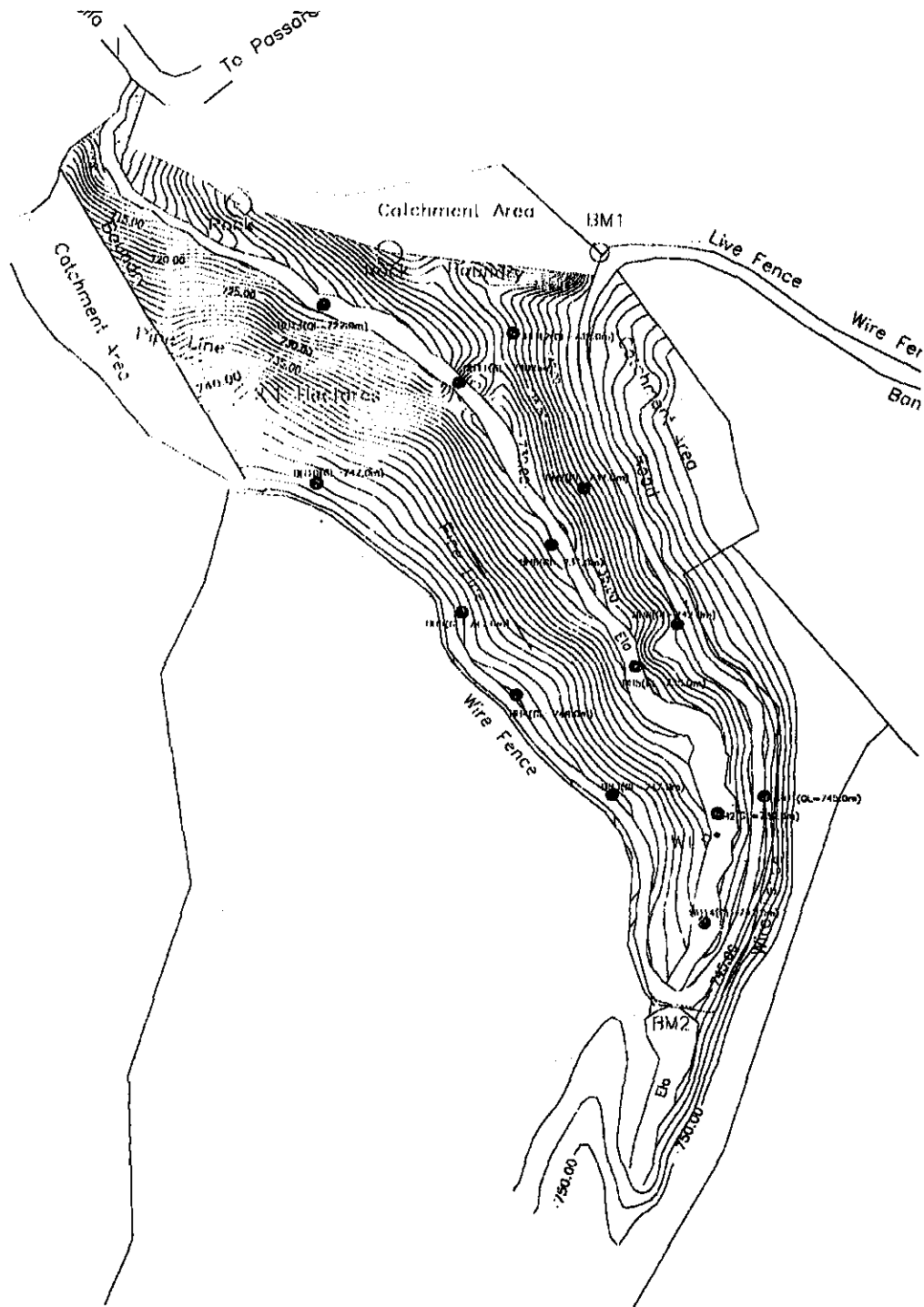


Fig.1 - Location of Boreholes.

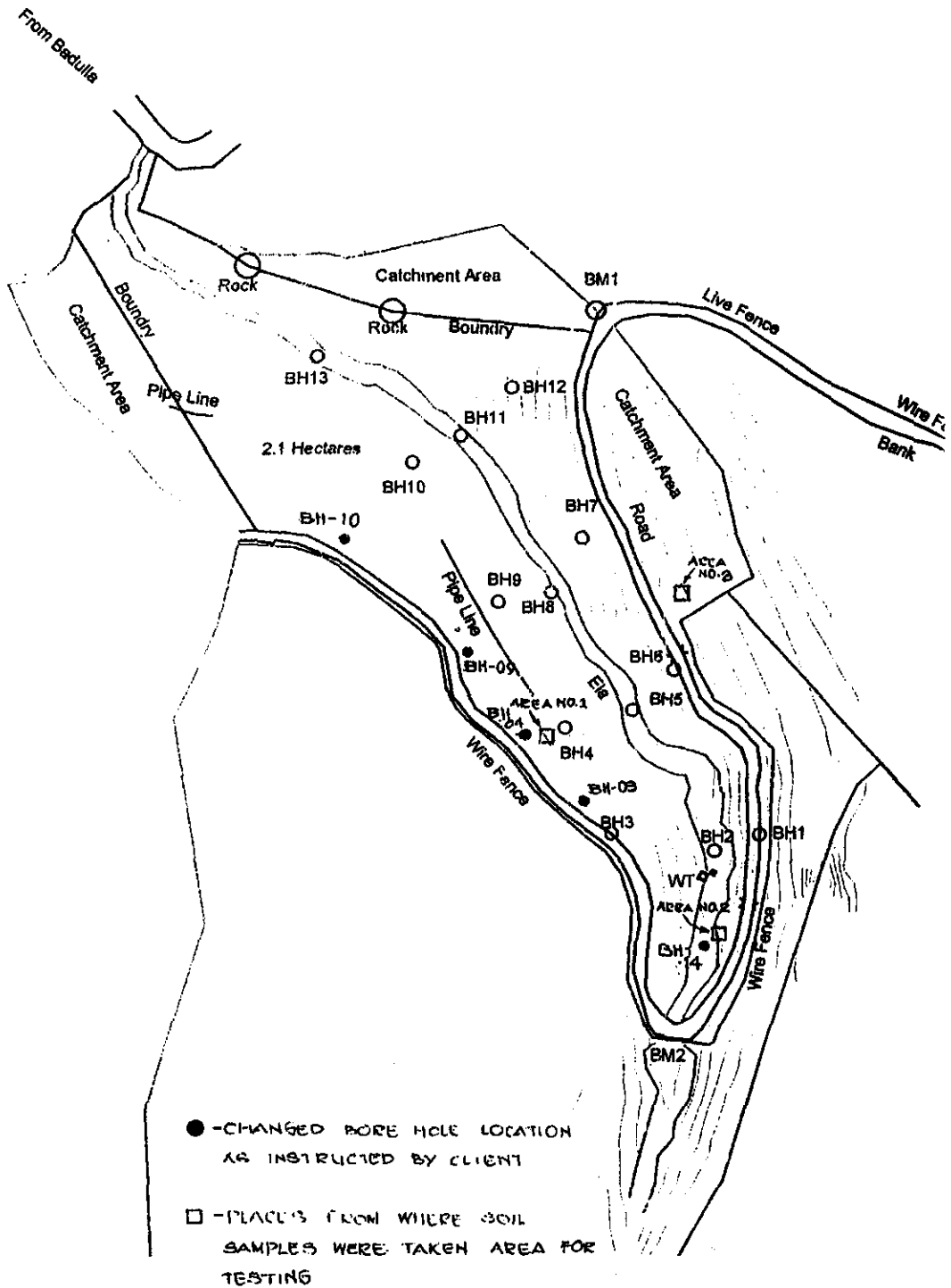


Fig.2 - Location of Boreholes and Test Areas

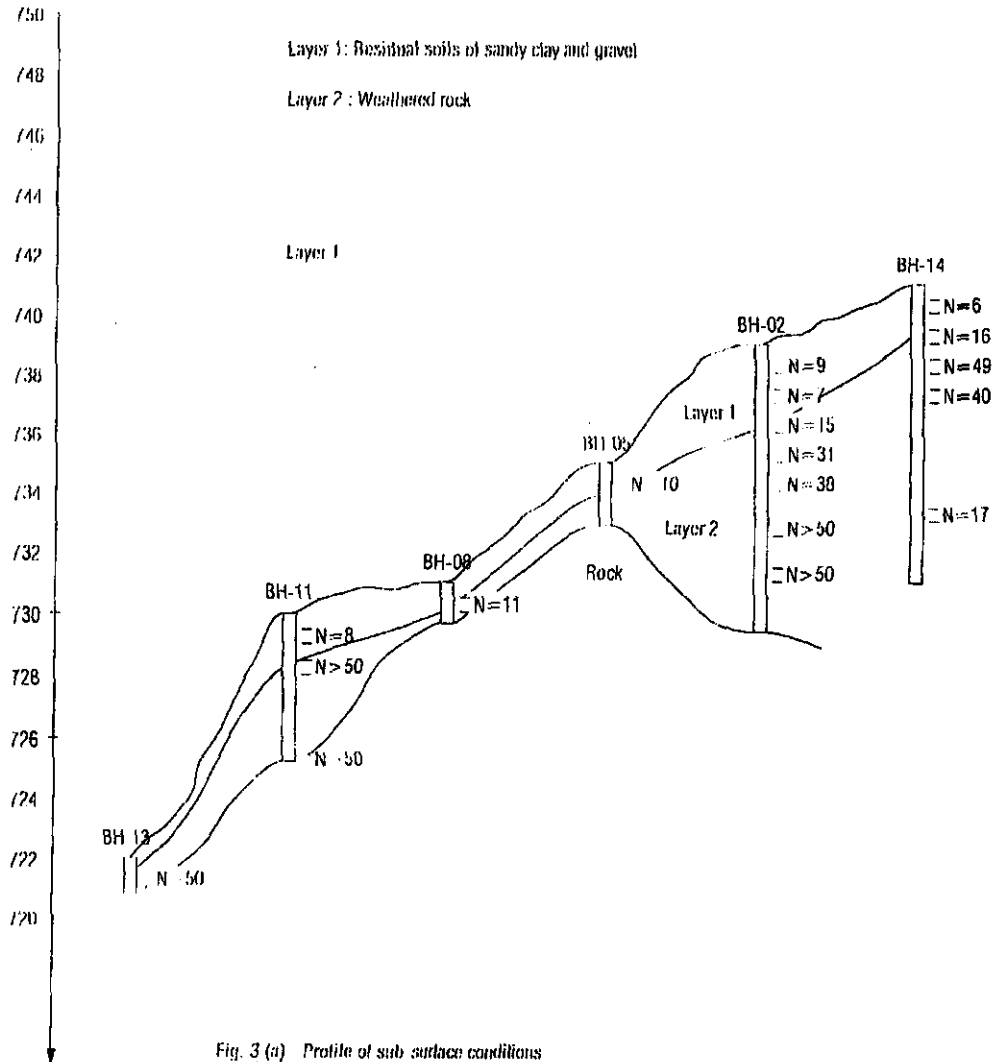


Fig. 3 (a) Profile of sub surface conditions across borehole BH-13, BH-11, BH-08, BH-05, BH-02 and BH-14.

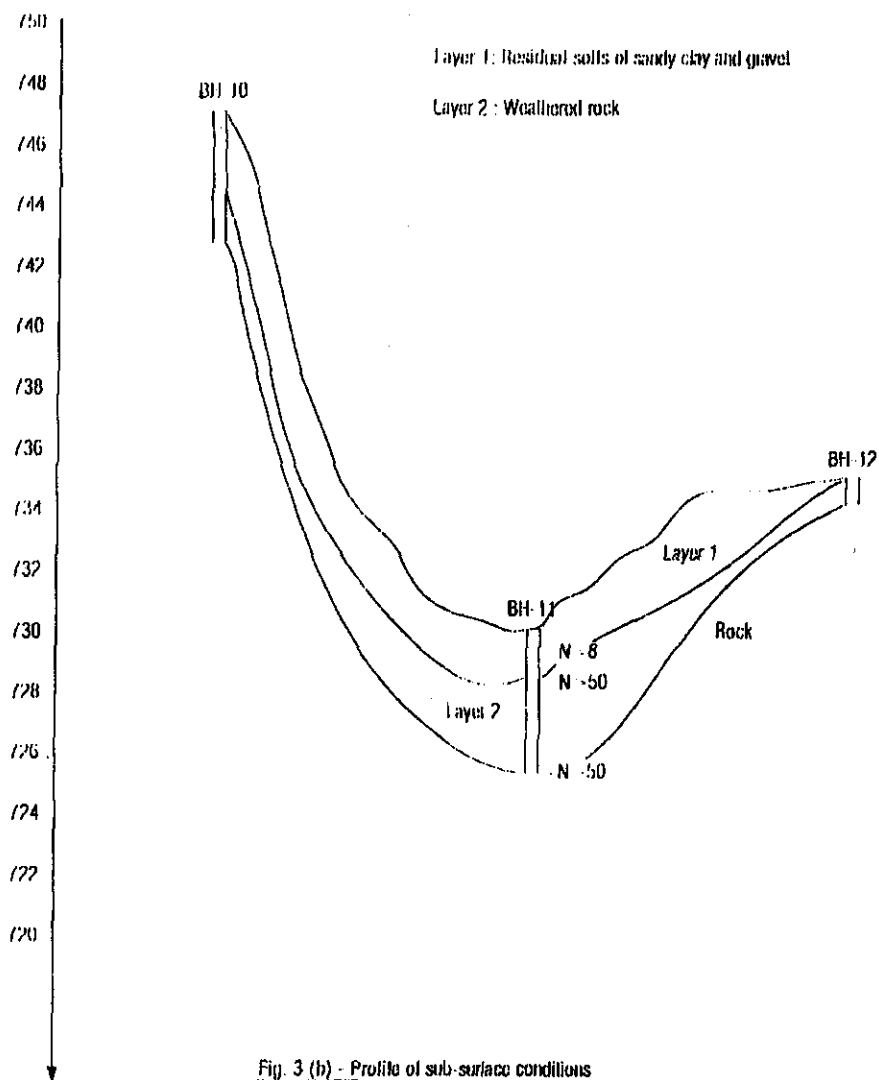
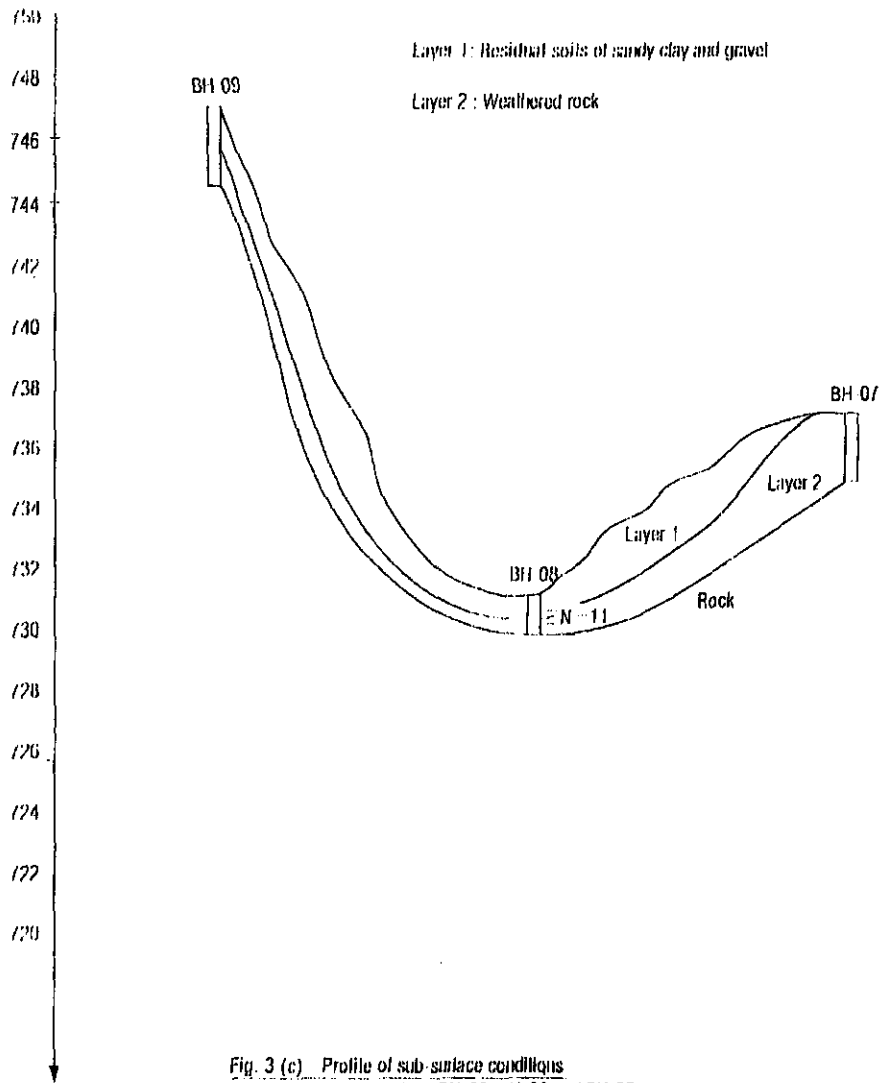


Fig. 3 (b) - Profile of sub-surface conditions
across borehole BH-10, BH-11, and BH-12.



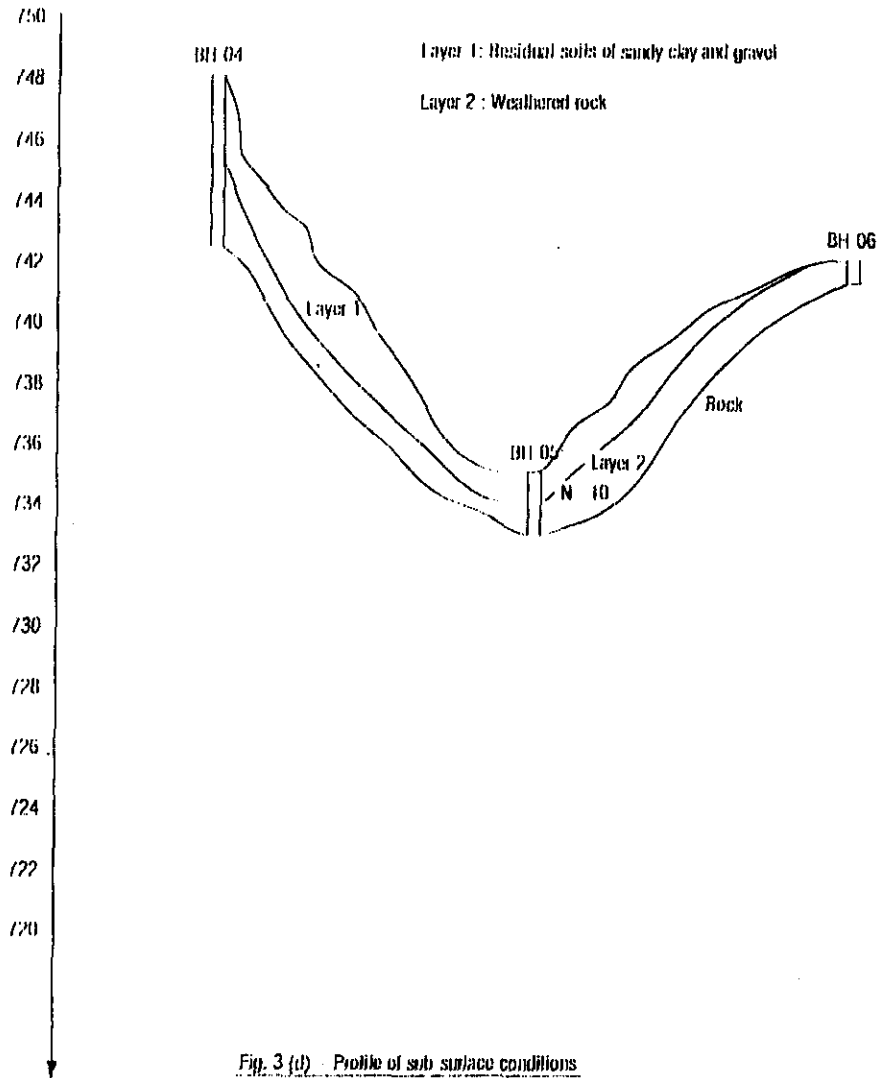


Fig. 3 (d) : Profile of sub surface conditions
across borehole BH 04, BH 05 and BH 06.

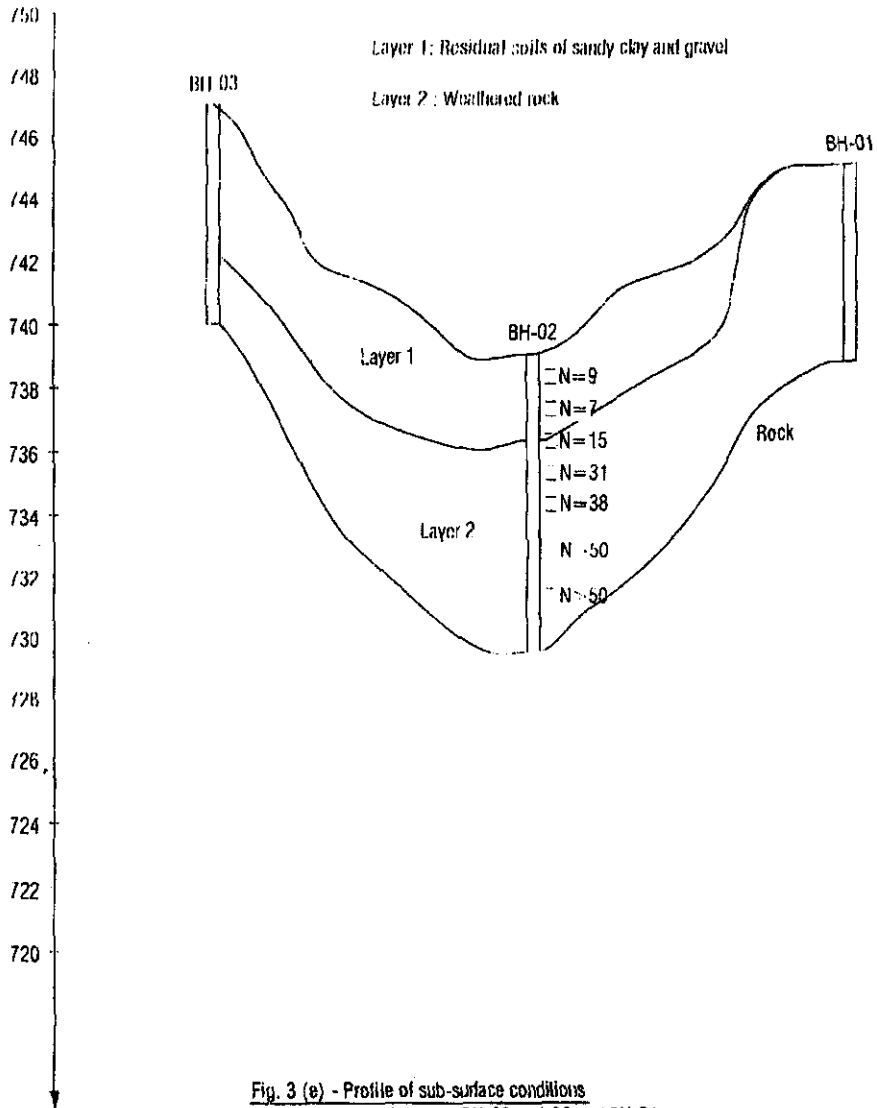


Fig. 3 (e) - Profile of sub-surface conditions
across borehole BH-03, BH-02 and BH-01.

APPENDIX 1: borehole Logs

BOREHOLE LOG				Job No: G/1512	Sheet : 1 of 1						
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 01	Level : MSL						
Consultant :-				Duration : 24/08/2003 to 24/08/2003							
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO							
				Logged by : P.S. Gamalath							
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values)				Depth (m)
							10	20	30	40	
01		BW			Reddish Brown Very highly weathered rock						01
02											02
03					Absorption test done at 3.00m						03
04					Reddish Brown Very highly weathered rock with quartz pieces						04
05											05
06		BW			Absorption test done at 6.25m						06 6.25
07					BH terminated						07
08											08
09											09
10											10
Comments:		Weather Condition: Dry	Rock level: 8.25m BH terminated: 6.25m	GWL: Nil	Absorption test done at 3.00m and 6.25m						


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BOREHOLE LOG				Job No: G1512	Sheet : 1 of 1													
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 02	Level : MSL													
Consultant :-				Duration : 16/08 2003 to 17/08/2003														
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO														
				Logged by : P.S. Gamalath														
D e p t h (m)	W a t e r (m)	C a s e (mm)	In situ Tests and Samples	S P T No	Lithological Description	L e g e n d	Penetration Resistance (Based on SPT values)				D e p t h (m)							
							10	20	30	40								
01		BW	0.50 0.95 SPT	9	Brownish Medium sandy clay and quartz pieces						01							
					Reddish Brown Medium clayey sand and gravel						1.20							
					Rock boulders quartzite						1.45							
02			GWL 1.50m 1.50 - 1.95 SPT	7	Coarse sand and quartz pieces						02							
03			2.50 - 2.95 SPT	15	Absorption test done at 3.00m						03							
04			3.50 - 3.95 SPT	31							04							
05			4.50 - 4.95 SPT	38							05							
					<table border="1"> <thead> <tr> <th>Depth (m)</th> <th>C/R %</th> <th>RQD %</th> </tr> </thead> <tbody> <tr> <td>1.20 - 1.40</td> <td>NR</td> <td>NII</td> </tr> </tbody> </table>	Depth (m)	C/R %	RQD %	1.20 - 1.40	NR	NII							05
Depth (m)	C/R %	RQD %																
1.20 - 1.40	NR	NII																
06			6.00 - 6.45 SPT	>50	Very highly weathered rock						06							
07											07							
08			7.50 - 7.95 SPT	>50							08							
09											09							
					Absorption test done at 9.55m						9.55							
10		BW			BH terminated						10							
Comments:		Weather Condition: Dry	Rock level: 0.55m BH terminated: 9.55m	GWL: 1.50m	Absorption test done at 3.00m and 9.55m													
GEOTECH LIMITED, 13/1, Pellyyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881																		

BOREHOLE LOG					Job No: G/1512	Sheet : 1 of 1					
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 03	Level : MSL					
Consultant :-					Duration : 23/06/2003 to 23/06/2003						
Project : Soil investigation for the study on improvement of solid waste management at Badulla.					Drilling Rig: TOHO						
					Logged by : P.S. Gamalath						
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values)				Depth (m)
							10	20	30	40	
01		BW			Brownish Medium to coarse clayey sand						01
02					Reddish Brown Medium to coarse sandy clay with quartz pieces						02
03					Reddish Brown Fine to coarse sandy clay						03
04					Absorption test done at 3.00m						04
05					Very highly weathered rock						05
06											06
07		BW			Absorption test done at 7.00m						07
08					BH terminated						08
09											09
10											10
Comments:		Weather Condition: Dry	Rock level: -	BH terminated: 7.00m	GWL: Nil	Absorption test at 3.00m and 7.00m					
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881											

BOREHOLE LOG				Job No: G1512	Sheet : 1 of 1						
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 04	Level : MSL						
Consultant :-				Duration : 23/08/2003 to 23/08/2003							
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO							
				Logged by : P.S. Gamalath							
D e p t h (m)	W a t e r (m)	C a s e (m)	In situ Tests and Samples	S P T No	Lithological Description	L o g g e r	Penetration Resistance (Based on SPT values)				D e p t h (m)
							10	20	30	40	
01		BW			Brownish Fine to medium sandy clay with quartz pieces						01
02					Yellowish Brown Very highly weathered rock <i>Absorption test done at 3.50m</i>						02
03											03
04					Brownish Very highly weathered rock						04
05											05
06		BW			BH terminated						5.80
07											07
08											08
09											09
10											10
Comments:		Weather Condition:	Dry	Rock level: BH terminated:	5.80m	GWL:	Nil	Absorption test done at 3.50m			
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BOREHOLE LOG				Job No: G/1512	Sheet: 1 of 1														
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 05	Level: MSL														
Consultant :-				Duration : 10/08/2003 to 18/08/2003															
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO															
				Logged by : P.S. Gamalath															
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values)				Depth (m)								
							10	20	30	40									
01		BW			Brownish Sandy clay with plant roots							01							
					Brownish Sandy clay with quartz pieces							1.40							
02		BW			Rock quartz Absorption test done at 2.10m							2.10							
03					BH terminated							03							
04					<table border="1"> <thead> <tr> <th>Depth (m)</th> <th>C/R %</th> <th>RQD %</th> </tr> </thead> <tbody> <tr> <td>1.40 - 2.10</td> <td>Nil</td> <td>Nil</td> </tr> </tbody> </table>	Depth (m)	C/R %	RQD %	1.40 - 2.10	Nil	Nil								04
Depth (m)	C/R %	RQD %																	
1.40 - 2.10	Nil	Nil																	
05												05							
06												06							
07												07							
08												08							
09												09							
10												10							
Comments:		Weather Condition: Dry	Rock Level: BH terminated: 2.10m	GWL: Nil	Absorption test done at 2.10m														
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881																			

BOREHOLE LOG				Job No: G/1512	Sheet : 1 of 1							
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 06	Level : MSL							
Consultant :-				Duration : 25/08/2003 to 25/08/2003								
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO								
				Logged by : P.S. Gamalath								
D e p t h (m)	W a t e r (m)	C a s e	In situ Tests and Samples	S P T No	Lithological Description	L e g e n d	Penetration Resistance (Based on SPT values)				D e p t h (m)	
							10	20	30	40		
		BW			Very highly weathered rock							0.76
01		BW			BH terminated							01
02												02
03												03
04												04
05												05
06												06
07												07
08												08
09												09
10												10
Comments:		Weather Condition: Dry	Rock level: -	BH terminated: 0.75m	GWL: Nil							

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BOREHOLE LOG					Job No: G/1512	Sheet: 1 of 1					
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 07	Level: MSL					
Consultant :-					Duration : 24/08/2003 to 24/08/2003						
Project : Soil investigation for the study on improvement of solid waste management at Badulla.					Drilling Rig: TOHO						
					Logged by : P.S. Gamalath						
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values)				Depth (m)
							10	20	30	40	
01		BW			Very highly weathered rock						01
02											
		BW			Absorption test done at 2.30m						2.30
					BH terminated						
03											03
04											04
05											05
06											06
07											07
08											08
09											09
10											10
Comments:		Weather Condition: Dry	Rock level: -	BH terminated: 2.30m	GWL: Nil	Absorption test done at 2.30m					

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BOREHOLE LOG				Job No: G/1512	Sheet: 1 of 1									
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 08	Level: MSL									
Consultant :-				Duration : 24/08/2003 to 24/08/2003										
Project : Soil Investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO										
				Logged by : P.S. Gamalath										
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values)	Depth (m)						
01		BW	0.50 - 0.95 SPT	11	Reddish Brown Clayey sand			0.93						
		BW			Reddish Brown Sandy clay and rock pieces			01						
					Absorption test done at 1.30m			1.30						
02					Rock quartz			02						
					BH terminated									
03								03						
					<table border="1"> <thead> <tr> <th>Depth (m)</th> <th>C/R %</th> <th>RQD %</th> </tr> </thead> <tbody> <tr> <td>0.93 - 1.30</td> <td>Nil</td> <td>Nil</td> </tr> </tbody> </table>	Depth (m)	C/R %	RQD %	0.93 - 1.30	Nil	Nil			
Depth (m)	C/R %	RQD %												
0.93 - 1.30	Nil	Nil												
04								04						
05								05						
06								06						
07								07						
08								08						
09								09						
10								10						
Comments:		Weather Condition: Dry	Rock level: -	BH terminated: 1.30m	GWL: Nil	Absorption test done at 1.30m								
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BOREHOLE LOG					Job No: G/1512	Sheet : 1 of 1					
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 09	Level : MSL					
Consultant :-					Duration : 24/08/2003 to 24/08/2003						
Project : Soil investigation for the study on improvement of solid waste management at Badulla.					Drilling Rig: TOHO						
					Logged by : P.S. Gamalath						
D e p t h (m)	W a t e r (m)	C a s e (mm)	In situ Tests and Samples	S P T No	Lithological Description	L e g e n d	Penetration Resistance (Based on SPT values)				D e p t h (m)
							10	20	30	40	
01		BW			Reddish Brown Sandy clay with quartz pieces						01
02					Very highly weathered rock with quartz pieces						02
		BW			Absorption test done at 2.50m						2.50
03											03
04											04
05											05
06											06
07											07
08											08
09											09
10											10
Comments:		Weather Condition: Dry	Rock level: -	BH terminated: 2.50m	GWL:	Absorption test done at 2.50m No penetration below 2.50m					
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BOREHOLE LOG				Job No: G/1512	Sheet : 1 of 1							
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 10	Level : MSL							
Consultant : -				Duration : 24/08/2003 to 24/08/2003								
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO								
				Logged by : P.S. Gamalath								
D e p t h (m)	W a t e r (m)	C a s e mm	In situ Tests and Samples	S P T No	Lithological Description	L e g e n d	Penetration Resistance (Based on SPT values)				D e p t h (m)	
							10	20	30	40		
		BW			Brownish Fine sandy clay and gravel							
01					Very highly weathered rock with big quartz pebbles							01
02												02
03					Absorption test done at 3.00m							03
04					Very highly weathered rock							04
		BW			BH terminated							4.30
05												05
06												06
07												07
08												08
09												09
10												10
Comments:		Weather Condition: Dry	Rock level: - BH terminated: 4.30m	GWL: Nil	Can not drive below 4.30m - Rock quartz at 4.30m Absorption test done at 3.00m							
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BOREHOLE LOG				Job No: G/1512	Sheet : 1 of 1											
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 11	Level : MSL											
Consultant :-				Duration : 24/08/2003 to 24/08/2003												
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO												
				Logged by : P.S. Gamalath												
Depth (m)	Water (m)	Case	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values)				Depth (m)					
							10	20	30	40						
01		NX	0.50 - 0.95 SPT	8	Brownish Medium sandy clayey with quartz pieces						01					
02			1.50 - 1.95 SPT	>50	Brownish Medium to coarse clayey sand with quartz pieces						02					
03					Brownish Coarse sand with quartz pebbles and boulders						03					
04					Very highly weathered rock large quartz pieces						04					
05	BW				Absorption test done at 4.78m						4.78 4.78 05					
06					Quartz						06					
07					BH terminated						07					
				<table border="1"> <thead> <tr> <th>Depth (m)</th> <th>C/R %</th> <th>RQD %</th> </tr> </thead> <tbody> <tr> <td>4.70 - 4.78</td> <td>Nil</td> <td>Nil</td> </tr> </tbody> </table>		Depth (m)	C/R %	RQD %	4.70 - 4.78	Nil	Nil					
Depth (m)	C/R %	RQD %														
4.70 - 4.78	Nil	Nil														
08											08					
09											09					
10											10					
Comments:		Weather Condition: Dry	Rock level: 4.78m	BH terminated: 4.78m	GWL: Nil	Absorption test done at 4.78m										
GEOTECH LIMITED, 13/1, Pepillyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881																

BOREHOLE LOG				Job No: G/1512	Sheet : 1 of 1							
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 12	Level : MSL							
Consultant :-				Duration : 24/08/2003 to 24/08/2003								
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO								
				Logged by : P.S. Gamalath								
D e p t h (m)	W a t e r (m)	C a s e	In situ Tests and Samples	S P T No	Lithological Description	L e g e n d	Penetration Resistance (Based on SPT values)				D e p t h (m)	
							10	20	30	40		
01		BW			Very highly weathered rock							0.85
		BW			BH terminated							01
02												02
03												03
04												04
05												05
06												06
07												07
08												08
09												09
10												10
Comments:		Weather Condition: Dry		Rock level: BH terminated: 0.85m		GWL: Nil						

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BOREHOLE LOG					Job No: G/1512	Sheet: 1 of 1		
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 13	Level: MSL		
Consultant :-					Duration : 24/08/2003 to 24/08/2003			
Project : Soil investigation for the study on improvement of solid waste management at Badulla.					Drilling Rig: TOHO			
					Logged by : P.S. Gamalath			
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values) 10 20 30 40	Depth (m)
01		BW			Yellowish Brown Fine to medium clayey sand and gravel			01
		BW			Medium to coarse sand with large pieces of quartz			1.20
					Absorption test done at 1.20m			
02					BH terminated			02
03								03
04								04
05								05
06								06
07								07
08								08
09								09
10								10
Comments:		Weather Condition: Dry	Rock level: 1.20m BH terminated: 1.20m	GWL: Nil	Absorption test done at 1.20m			
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BOREHOLE LOG				Job No: G1512	Sheet : 1 of 1							
Client : Kokusai Kogyo Co. Ltd.				B.H. No: 14	Level : MSL							
Consultant : -				Duration : 24/08/2003 to 24/06/2003								
Project : Soil investigation for the study on improvement of solid waste management at Badulla.				Drilling Rig: TOHO								
				Logged by : P.S. Gamalath								
D e p t h (m)	W a t e r (m)	C a s e mm	In situ Tests and Samples	S P T No	Lithological Description	L e g e n d	Penetration Resistance (Based on SPT values)				D e p t h (m)	
							10	20	30	40		
01		BW	0.50 - 0.95 SPT	5	Reddish Brown Fine to medium clayey sand							01
02			1.50 - 1.95 SPT	16	Brownish Medium to coarse clayey sand							02
03			GWL 2.45m 2.60 - 2.95 SPT	49	Reddish Brown Medium to coarse sandy clay with pieces of quartz							03
04			3.50 - 3.95 SPT	40	Absorption test done at 3.00m Reddish Brown medium to coarse sand with clay and pebbles							04
05												05
06					Yellowish Brown Very highly weathered rock							06
07												07
08			7.50 - 7.95 SPT	17								08
09					Brownish Very highly weathered rock							09
10		BW			Absorption test done at 10.00m							10
Comments:		Weather Condition: Dry	Rock level: BH terminated: 10.00m	GWL: 2.50m	Absorption test done at 3.00m and 10.00m							

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APPENDIX 2: Permeability Test Results

ABSORPTION TEST IN FEILD.

PROJECT: *Geological Survey for the Study on Improvement of Solid Waste Management at Badulla.*

LOCATION: *BH-01*

DEPTH OF HOLE: *3.00 m*

CASING BELOW GROUND LEVEL: *2.00 m*

CASING ABOVE GROUND LEVEL: *1.00 m*

WATER LEVEL AT BEGINNING OF TEST: *1.55 m*

WATER TAKEN TO FILL UP TO TOP OF CASING: *4.27 l*

READING

*WATER LEVEL FROM TOP OF CASING

**WATER TAKEN TO FILL UP TO TOP OF CASING

TIME	*DEPTH (m)	**VOLUME (l)
05 min	1.03 m	3.820 l
10 min	0.05 m	0.020 l
15 min	0.02 m	0.010 l
20 min	0.02 m	0.010 l
25 min	0.02 m	0.010 l
30 min	0.02 m	0.010 l
35 min		
40 min		
45 min		
50 min		
55 min		
60 min		
65 min		
70 min		
75 min		

GEOTECH LIMITED

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