

Organizational Information Sheet

Interview date : 2002/06/13

Name of the organization:	Sithuwama
Name of the chairperson:	Mr. Chandana Bandara (Chairman + Executive Director
Address and contact number:	24/19, Kachcheri RD, Matale. Tel: +94-66-30829 Fax: +94-66-30829 E- mail: Stedo@slt.net.lk
Year of establishment:	1996

1. General information

- No. of personnel: 25 full time staffs (4 person for office and 21 for field) This NGO gives their field assistants on hired basis to other institution. These days there are 15 field officers working for the National Water Supply and Drainage Board.
- Fund resource: Ministry of Environment, Unicef, Canadian Development International Agency, Shining Life Children Trust Fund
- Working area: Mainly community development and other social and economic activities in Matale, Anuradhapura, Kurunegala and Puttalam District.

2. Main activities

With Ministry of Environment

Bio diversity, soil conservation, agro forestry, home gardening, nurseries, production of organic fertilizer (compost), and Integrated Pests Management.

With UNICEF, Shining Life Children Fund and CIDA

House-based child care, awareness program for parents, child rights awareness, early child care development centers, women empowerment (gender) and small savings and credits. All these activities are carried out through CBOs.

Water Project

They have 5 water projects at present and help Community Based Organization to identify suitable locations of safe water source and prepare action plan.

3. Cooperation with other organizations

This NGO is actively participating in following forums and organization.

1. Member of National NGO forum. (There are more than 300 NGOs in this forum)
2. Matale district organizer of Central Province Child Rights Group
3. Chairmen of project steering committee of Matale District Community Environment Forum
4. Member of Environment committee of MC- Matale
5. Member of District Environment Committee, and so on.

Following organizations are members of Matale NGO Forum

- | | |
|--|-----------------------------------|
| 1. Sithumina | 9. Arunalu |
| 2. Sanasa | 10. Dambulla praja sampath center |
| 3. Sarvodaya | 11. Saukyadana |
| 4. Shanthi Nikethana | 12. Sarvodaya seeds |
| 5. Sathmanga Saraniya | |
| 6. Red Cross | |
| 7. SECDO | |
| 8. Kandurata sobha daham rasika havula | |
| 9. Surekuma | |

4. Future cooperation with the pilot project of the study team

They seem quite capable of cooperating with pilot projects in a very efficient way. Followings are spheres which they can cooperate with pilot projects.

1. Community awareness and monitoring
2. Marketing of compost
3. Training the community on compost
4. Supervision of garbage collection
5. Providing their training center for project activities (It has residential facility for 25 persons)

Activities of Divisional Environmental Officers

Interview date : 2002/07/01

Name of the Municipality:	Matale Municipal Council
Name of the officer:	Mr. Wasalage,
Year of appointment:	1997
Address and contact number:	Matale Municipal Council 066- 22285

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

One Divisional Environmental Officer (DEO) work under Health section of MMC.

2. Main activities

2.1 School Program

As same as Kandy, EPB programs are much more active than newly introduced Eco Club program. Mr. Wasalage, a DEO appointed by CEA, takes an active role to vitalize environmental education programs in cooperation with MMC and respective schools. From the beginning, 16 schools out of 17 in the MC area, participated in the EPB program. Following are the schools which they established environment pioneer brigade groups.

No.	Activeness	Name of school	No of groups	No.	Activeness	Name of school	No of groups
1	<input type="checkbox"/>	St. Thomas	1	9	<input type="checkbox"/>	Vijayapala V	1
2	<input type="checkbox"/>	Ismalia	1	10	<input type="checkbox"/>	Sri Sangamitta Balika	4, 5
3	<input type="checkbox"/>	Wariyapola	1	11	<input type="checkbox"/>	Amina	2
4	<input type="checkbox"/>	Hulangamuwa V	1	12	<input type="checkbox"/>	Christ Church	1
5	<input type="checkbox"/>	Dodamdeniya V	1	13	<input type="checkbox"/>	Vijaya	3
6	<input type="checkbox"/>	S.Bandaranayake	1	14	<input type="checkbox"/>	Zahira	1
7	<input type="checkbox"/>	Sujatha Balika	2	15	<input type="checkbox"/>	Parkyam	1
8	<input type="checkbox"/>	Hindu College	2	16	<input type="checkbox"/>	Science College	1

District environmental commissioner is in Vijaya College and Divisional environmental commissioner is in Sri Sangamitta balika. According to the DEO, the later person is more active.

2.2 Environmental Committee

This was established based on the guideline by CEA on 2001.02.09. There are 35 active members in the committee and once in 3 months they hold meetings. Unlike Kandy, committee

meeting are hold monthly, and there are about 35 active participants such as council members, representative of NGOs and Community Based Organizations, and school teachers.

2.3 Other activities

Other activities are specific programs on special days such as International Environment Day and Trees Planting Day, handling with environmental complaints from citizens and so on.

Chapter 4

Matale Pilot Projects

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Chapter 4 Matale Pilot Project

4.1 Process of Pilot Project

MMC / JICA Initial Meeting

Date: June 16, 2003

Participants:	MMC	MOH	JICA	Dr. S. Finnigan	Ms. M. Oishi
		CPHI		Ms. Nayana	Ms. Subhashini

To Do List of MMC

- ☐ Prepare the map within 4 weeks
 - ☐ Trailer design and its rough sketch by 23rd June 2003
 - ☐ Prepare a quotation from the State Trading Corporation (Tractor)
 - ☐ Design and location of litter bins by 23rd June 2003
 - ☐ Handcart design by 23rd June 2003
 - ☐ Decision on bell collection system in pilot areas by 23rd June 2003
 - ☐ Further internal discussion regarding fabrication of transfer platform
-

Decided Matters:

1. A map for the control board

MC will make a request to Survey Department and try to obtain the latest one (hard copy + digital copy) within 4 weeks.

2. Location of trailers

- One JICA funded trailer at Gongawela market
- Another JICA trailer at Park lane.
- (MC own trailer at Vihara Rd., near temple, or use JICA trailer on different days at Park Lane and here)

3. Design of trailers

MC will decide a design and prepare a rough sketch by 23rd June 2003

Note: MC will get a quotation and time estimate for construction from the State Trading Corporation (tractor). They do not prefer the products of Niku.

4. Fabrication of waste transfer platform

- Excavation work by MMC at Gongawela market
- Fabrication of transfer area (ramp + platform) is planned both at Park lane and Vihara Rd. Reminder! Total JICA budget for the whole fabrication is Rs.30,800. Any additional expenditure will have to be met by MMC.

5. Litter bins (Movable, Fixed, School)

MC will decide the type of bins (now considering the plastic "wheelie bin"), locations to place them (public and schools) by 23rd June 2003.

6. Modified handcarts

All will be used for municipal collection work. The design will be finalized by 23rd June 2003.

7. Bell collection

Pilot areas : Kotuwagedara (2–3 times / week) and Muslim Town (possibly daily collection)

System: MC will decide the detailed system of bell collection for each area by 23rd June.

Publicity: MC in collaboration with JICA study team will prepare leaflets in Sinhala and Tamil and CDAs will carry out house-to-house awareness visit with leaflets.

Other decided matters regarding bell collection:

- On 23rd June At 7:30am, Awareness programme to labourers
- On 23rd June At about 10:00am, MMC/JICA planning meeting
- On 23rd June At 1:30pm, Supervisors training
- By 25th June MC will fix the amplifier/speaker sets
- On 30th June Awareness programme to council members
(bell collection + other pilot projects.)

8. Discussion on Matale Disposal Site

Will be held at 10 o'clock on 24th June. Mayor and Commissioner will participate in the meeting.

MMC / JICA Labourers Meeting

Date: June 23, 2003

Participants:	MMC	MOH	JICA	Dr. S. Finnigan	Ms. N. Samaraweera
		CPHI		Ms. M. Oishi	Ms. S. Senevirathna
				Mr. Sashikumar	

- Purpose: meeting with all labourers to inform them about proposed pilot projects and to get their comments/ideas.
- Presentation were made by Ms Subashini and Mr Shashikumar, followed by questions and then a small meeting with a group of about 6 labourers, 2 supervisors, CPHI and MOH, discussing practical aspects of equipment design, as summarized below:
 - a. Bincarts not suitable for some areas of Matale – people discharge garbage as well.
 - b. Awareness needed for MC members.
 - c. Agreed on trialing bincart with 6 x 50L buckets and razor wheels.
 - d. Agreed on slope of ramp = 1:4 and 1.5m width.

MMC / JICA Progress Meeting

Date: June 23, 2003

Participants:	MMC	MOH	JICA	Dr. S. Finnigan	Ms. N. Samaraweera
		CPHI		Ms. M. Oishi	Ms. S. Senevirathna
		DEO		Mr. Sashikumar	

Discussed Matters:

1. Trailers

MMC will send a design (based on 6.5m³ capacity) to State Trading Corp. (Tractor) for a quotation (incl. Delivery + painting (2 coats – anti-corrosion and light green) and construction time).

2. Litter bins

- For fixed type (20), MMC have proposed their own design fixed to lamppost or stand, as their footpaths are relatively narrow. Cost is around Rs.1,500. The capacity will be around 50 – 60 L.
- For movable type (20), MMC prefers the half barrel bins in a portable stand.
- For schools, ordinarily 50 litre plastic dustbins. The idea of “wheelie bins” was rejected as these bins are not available locally. Planned allocation is as follows:

No.	Name of school	No. of students	Allocated no.
1	St. Thomas	1,877	10
2	Sangamiththa BMV	3,124	16
3	Hindu College	1,505	8
4	St. Thomas Girls	736	4
5	Pakkiya V	1,448	7

Note: These are problematic schools either with large numbers of students or without big grounds, making self-disposal difficult. Some of them have requested the MOH to send MC labourers to their schools. Allocated number of dust bins based on one per 200 students. Colours are green for bio-degradable and blue for non-degradable waste.

3. Modified handcart

They prefer a little higher (1.5 feet) and solid iron sheet sides with removable panel at front end like ordinary handcarts with 6 buckets. Green colour carts and orange dust bins are preferred. MMC needs to buy bins first and then finalise dimensions.

4. Bell collection

- Kotuwagedara, Hulangamuwa, Dodandeniya: collect garbage every other day except Sundays.
- Muslim Town, Rattota Rd and Riverside Rd: daily.

5. Transfer station

To be discussed further with the Municipal Engineer.

6. Other

- Draft monthly report handed over to CPHI – asked to fill from 1 Jul.

MMC / JICA Progress Meeting

Date: July 2, 2003

Participants:	MMC	MOH	JICA	Dr. S. Finnigan	Ms. N.Samarawera
		CPHI		Ms. M. Oishi	Ms. S.Senevirathna

Discussed Matters:

1. Trailers

MMC will fax a design (with dimensions amended to give 6.5 m³) to Nirosh Industries today in order to obtain information on cost (including delivery and painting (2 coats – anti-corrosion, light green)) and construction time. The quotation should be ready by the end of this week (4 Jul).

* It was found that the State Trading Corporation (Tractor), where MMC planned to get a quotation from, has closed down.

* Niku took six weeks to produce trailers. In contrast, Nirosh Industries said it can produce trailers within a week. If the quotation is reasonable, JICA will visit Nirosh Industries to check their capability.

2. Litter bins

- For fixed type (20), MMC will find a company which can produce such bins (MMC's own design) within the budget. (Note: MMC does not have to submit quotations for things whose cost per item is less than approximately Rs.80,000 to the JICA study team.)
- For movable type (20), MMC prefers JICA's half barrel non-turnable bins.

3. School dust bins

- For schools, ordinary 50L plastic dustbins (40) to be used. Since some schools have difficulties disposing of their wastes, MMC will establish a system of collecting school wastes according to the following schedule:
 1. Prepare draft school waste collection policy by MOH and CPHI. (see below).
 2. Discuss this draft at the MMC health committee meeting and finalize MMC's proposed system.
 3. Consult with all the school principals in MMA and finalize the school waste collection system.
 4. Publicize the system to all schools in MMA.
- The draft of *the school waste collection system* by MOH and CPHI with the JICA study team is as follows:
 1. Reinforce polythene prohibition and promote the use of reusable lunch boxes.
 2. Compost biodegradable wastes, where possible. If no space to dispose of such biodegradable wastes within the school premises, MMC will collect large piles, for example, every two to three weeks, according to MMC's schedule.
 3. Don't discharge any wastes outside the school premises or into drains and streams running through the school premises.

4. For large wastes, i.e. after festival or special events, call MMC to arrange collection for free in advance. (possible fee for private schools?).

4. Modified handcart

MMC will contact two possible producers of modified handcarts (Chamikara and Wattegama P.S.). The size is 1.5" (H) × 3" (W) × 4.5" (L), based on measuring MMC office dustbins (50L capacity). 70% of handles to be covered by iron mesh. Razor wheels. Support bracket to be attached only to the back end of handcart. Note: measured dimensions give total capacity of 573L, compared with standard HC = 4ft x 2.5ft x 1.5ft = 15ft³ = 420L; new HC is approx 33% bigger. It was decided this was okay.

5. SWM control board

- MMC have a good map for the control board, so no need for other maps.
- Size and usage will be discussed and decided by MMC.

6. Transfer station

Detailed design will be decided after MMC obtains new trailers.

7. Schedule

The updated schedule of bell collection system was decided:

- | | |
|------------|--|
| By July 7 | Draft content of leaflets and notice boards prepared. |
| By July 11 | Content of leaflet and noticeboards finalized |
| By July 18 | Sufficient leaflets to be printed for stage 1 of bell collection. |
| By July 25 | 30-40 noticeboards to be completed for stage 1 + locations for these noticeboards to be selected + leaflets for stage 1 to be distributed. |
| By July 31 | 30-40 noticeboards to be installed. |
| July 28 | Labourer training for bell collection. |
| On Aug 1 | Start of the bell collection |

MMC / JICA Progress Meeting

Date: July 7, 2003

Participants:	MMC	MOH	JICA	Dr. S. Finnigan	Ms. N.Samarawera
		CPHI		Ms. M. Oishi	Ms. S.Senevirathna
		DEO			

Discussed Matters:

1. Trailers

Rs.122,500 incl. VAT and painting, but excl. transportation. Mr.Sato is going to check the company (Nirosh) on 8th July 2003. MMC needs to arrange transport to Matale.

2. Modified handcart

Chamikara's price is approximately Rs.13,000 with 20% VAT. (price without VAT is about Rs.10,800.) Wattegama UC's price is more expensive.

3. Litter bins

Both fixed and movable type will be fabricated at Chamikara within the budget.

4. School dust bins

MMC will buy them from any shop in Matale.

5. School Waste Collection System

The proposed idea discussed on 2nd July 2003 is going to be presented at the Monthly Health Committee Meeting on 9th July 2003. Decided matters at the Health Committee are discussed at the General Meeting and it usually takes one month to finish all the discussion process at different levels.

6. SWM control board

The map sticker (6"×2.5") is being prepared by Digital Teleprints (Kandy) and will be ready on 9th July 2003. The white board is also planned to be the same size (6"×2.5").

7. Leaflet / Noticeboard

- The leaflet publicizing the bell collection system is going to be produced first (2,000). The draft contents of this leaflet will be ready before 9th July 2003. (Note: this leaflet is different from the one being prepared with Ms. Kitajima.)
- The contents of notice boards will be ready by the same time.
- Meeting regarding leaflets/notice boards will be held at 9 a.m. on 9th July 2003.

8. Landfill site

- CPHI had to leave meeting to go to protest meeting about new landfill site. According to MOH, MMC is covering with soil every Wednesday and Saturday using the JCB.
- 4 MMC labourers assigned to the new landfill site can cover the garbage with soil manually, but as there are no hut nor water supply at the disposal site, they can not work there for the whole day.
- The method of soil coverage was explained by Dr. Sean, and the MOH understood well. It seems that the problem is that the persons at the site have not been well instructed.

MMC / JICA Progress Meeting

Date: July 9, 2003

Participants:	MMC	MOH	JICA	Dr. S. Finnigan	Ms. N.Samarawera
		CPHI		Mr. Sashikumar	Ms. S.Senevirathna

Discussed Matters:

- **Trailer:** JICA informed MMC that trailer order was made on 8 Jul, after Mr Sato inspected factory. JICA is to check trailer dimensions before assembling on 11th Jul; trailers will be complete on 19th July. MMC to arrange delivery of trailers to Matale on that day. Surplus JICA budget available for transportation = 18,000Rs.
- **Leaflet:** words for leaflet finalised. MMC to typeset and print 2,000 copies initially. No need for advance payment. Budget cost (2,000/7,000 of total budget) = 18,600 incl. VAT.
- **Noticeboard:** words for noticeboard finalised in sinhala. MMC to prepare in tamil. JICA/MMC visited noticeboard company to discuss details – words will be put onto noticeboard as a sticker, with different noticeboards being used for sinhala and tamil. Company to give quotation to MMC after seeing how many words are to be printed. MMC has to select noticeboard locations in bell collection areas and decide how many noticeboards can be fixed to existing permanent surfaces (walls, etc.) and how many stands are needed. There is no additional budget for stand construction.
- **Litter bins and handcarts:** Chamikara quotation was too high. Following JICA/MMC negotiation with Chamikara, price was reduced to within budget. Order given and advance payment of 30,000Rs made. JICA/MMC to inspect handcart on 13 Jul prior to welding.
- **Landfill protest meeting outcome (7 Jul):** Appointed Monitoring committee, comprising 5 people from villages and remaining from PS/MC staff. First meeting on 11 Jul. Due to concerns raised by villagers, MMC sprayed filled area at new landfill site yesterday with insecticide and applied 75-100mm of soil cover. JCB will continue to apply soil cover twice weekly. Chief Minister visited yesterday. At playground (temp disposal site), MMC have sprayed insecticide but have not cleaned it up nor applied final cover.
- **Carekleen:** MMC currently discussing old Carekleen proposal concerning privatisation of the city centre garbage collection and transportation.
- **Nature Care:** CPHI and MOH were not aware of Nature Care's planned visit to Matale on 15 Jul concerning possible composting project.
- **Post-meeting telephone conversations:**
 - **Colour:** CPHI selected Kenlux "apple green" as colour of handcarts and bins (manufacturer: Coastway Paints, Lanka Pvt Ltd, No 50 Royal Mendis Mw, Modarewila Industrial Estate, Panadura.

MMC / JICA Progress Meeting

Date: July 14, 2003

Participants:	MMC	JICA		
	MOH	Dr. S. Finnigan	Ms. N.Samarawera	Mr. N. Sato
	CPHI	Mr. Sashikumar	Ms. S.Senevirathna	Dr. P. Rei
	DEO	Ms. M.Oishi	Mr.A.Karunaratna	

Discussed Matters:

1. Landfilling

- MMC have had to stop landfilling again due to public protests. The landfill is now to be approved by Chief Minister of Central Province. The protest gathering was of political origin, and therefore MMC are resorting to a political solution.
- However, MMC supports JICA's idea of forming a monitoring committee like in Kandy and Nuwara Eliya since it is 1) good to ensure MMC's landfilling practices are sufficient and sustainable, and 2) useful to explain to and get support from outsiders such as NGOs or politicians.
- The monitoring checklist will be prepared by Mr. Sato and given to MMC on Wednesday.
- The evaluation report should be publicized both at a public meeting (e.g. at temple) and MMC.

2. CEA Permission

- MMC have received two letters from CEA. One is from CEA DG (Jul 03) and the other from the IEE/EIA department (May 03). The letter from DG implies granting of permission for composting and dumping yard. However, the letter from IEE/EIA states that MMC needs to submit a comprehensive report on the landfill site and a landfilling plan.
- DEO has some documents on landfilling regulations, such as the size of the buffer zone, fly control, etc..

3. Collection Improvement

- Leaflet: 2000 leaflets will be printed within this week.
- Notice Board: Cost is Rs. 1,500 incl. VAT. The location of notice boards will be decided by 16th July.
- Litter bins and handcarts: Drawings given to Chamikara. Dr. Sean visited their factory on 14th July. MOH/SPHI also to visit as some issues require resolving (movable litter bins: height of triangular base support, holes for drainage; fixed litter bins: 24" high cf. 19" for bin measured at MMC + mesh size too thin?; HC: 3'6").
- SWM control board: Sticker not yet completed. Dr. Sean will check when it will be ready.

4. Waste Minimization

- Home composting is planned under SCP. One third of this year's SCP budget, Rs.1.5 million, will be spent for composting. (Another one third for drainage improvement in MC Pala and the other one third for billboards).
- Centralised composting: Trying to obtain funds under UDLIHP (UDLIHP now doing awareness programmes to PHIs / supervisors).

- Biogas: They received a letter from NERD Centre today about biogas. Sevanatha also recommends smaller scale biogas facilities using market waste like in Kotte. Although there are some ideas/proposals MMC has not decided anything concrete yet regarding biogas at this stage.
- The outline programme for promotion of traditional recycling was explained. The details, especially MMC's cooperation, will be discussed after the BPK focus group discussion.

MMC / JICA Progress Meeting

Date: August 1, 2003

Participants:	MMC	JICA		
	MOH	Dr. S. Finnigan	Ms. N.Samarawera	Ms. T. Kitajima
	CPHI	Ms. M.Oishi	Ms. S.Senevirathna	Mr.R.Kuruppuge

Discussed Matters:

1. Bell collection / Waste collection improvement

- Speaker/amplifier requires a 12V power supply. The small compactor's voltage is 12V and therefore no problem. If the voltage is 24V, it should be transformed down to 12V. There is no problem for tractors, but MMC has to consider how to avoid rain.
- Informing labourers and drivers regarding bell collection will be held at 7:30 a.m. on 2nd Aug.
- CDAs are visiting house to house and distributing 2,000 leaflets at present. Most probably they are going to finish distribution by Tuesday (5th Aug.).
- 20 Sinhala notice boards have been completed. Other 20 Tamil notice boards are not finished yet. Places to install notice boards have been decided, but installation has not been started.
- Handcarts, fixed bins, movable bins and trailers have all been delivered.
- There is no place for a ramp at Vihara Rd – hence, modified handcarts will be used here instead.
- The landfill evaluation report should be publicized both at a public meeting (e.g. at temple) and MMC.

2. Waste reduction

- It is difficult to lend out MC owned handcarts, but they can sell old carts at a cheaper rate.
- In order to promote traditional recycling, the following measures can be taken by MMC:
 - ✓ Provision of ID cards, including a system to check their reliability.
 - ✓ Awareness programmes to increase understanding of the traditional recycling system and probably arrange recyclables collection days in selected areas.
 - ✓ Allocation of some space in each community centre for temporary storage purposes.

3. Environmental Education

- Inform the commissioner of the latest developments in environmental education.
- Prepare one-year schedule for environmental education. (Sample made by Badulla MC given to CPHI).

MMC / JICA Progress Meeting

Date: August 9, 2003

Participants:	MMC	JICA	
	MOH	Dr. S. Finnigan	Ms. N.Samarawera
	CPHI	Ms. M.Oishi	Ms. T. Kitajima

Discussed Matters:

1. Bell collection / Waste collection improvement

- Driver/labourer training held on Aug 1.
- Bell system has been installed on the small compactor (approx. capacity = 2.5T, sufficient for 1,000 households). The big compactor is out of service now but MMC hope to repair by 15 August. In the interim period, they are using Works section tractors to cover for the big compactor.
- One of two new tractors to be bought with ADB funds will be used for garbage collection.
- One amplifier is out of order and has been given to JICA for repairs.
- The bell collection will be introduced first only in Kotuwegedara from 12th Aug, using small compactor.
- 20 Sinhala and 20 Tamil notice boards have been fabricated.
- MMC will start installation of 15 Sinhala notice boards in Kotuwegedara on 12th August.
- In Muslim town, the combined methods of stationary trailer, handcart and bell collection will be introduced once the big compactor is repaired.
- MMC is going to fix the bell collection system onto at least one new tractor.
- Distribution of leaflets by CDAs has been carrying out. Distribution at Kotuwegedara has been finished.
- JICA explained about possibly playing the bell music everywhere, rather than area by area.
- Regarding platform, Dr. Sean is going to give a design to MMC. EEC contractor will also construct the platform.
- Installation of fixed trash bins will be finished before 18th August. The places to install have been discussed and decided by MMC.

2. Environmental Education

- Good progress on construction of EEC.

3. Other

- Expanded meeting with Mayor, Commissioner, MOH and CPHI will be held on 14th afternoon. Mr. Doi will attend. MOH and CPHI will explain about the progress of JICA pilot projects before the court hearing on 15th August.
- Discuss how to form the action plan on 14th.
- Progress review presentation to wider audience at the City Development Programme on 28th by MMC and JICA.

- Landfill: MMC started using Oyapahara pit last week following a request from the owner to fill it up, but stopped this week due to strong protests by residents.

MMC / JICA Progress Meeting

Date: August 18, 2003

Participants:	MMC	JICA
	MOH, CPHI	Dr. S. Finnigan Ms. N.Samarawera
	DEO, CC	Ms. M.Oishi Ms. T. Kitajima Mr.R.Kuruppuge
		Ms. S.Senevirathna Mr. Sashikumar

Discussed Matters:

1. Action Plan (AP)

- Went through AP. Revised version produced following this meeting and another short meeting.
- Format for finalising AP – internal meeting – JICA/MMC → revised draft, community workshop → final draft.
- AP should look at both composting + landfilling vs landfilling. Also need short term interim plan to cover temporary landfilling site.

2. Other

- JICA handed over drawing of ramp to MMC
- Bell collection not started yet due to landfill problems.

MMC / JICA Progress Meeting

Date: August 25, 2003

Participants:	MMC	JICA		
	MOH, CPHI	Mr A.DoI	Dr. S. Finnigan	Ms. N.Samarawera
	DEO	Mr N.Sato	Ms. M.Oishi	Ms. T. Kitajima
		Mr.R.Kuruppuge	Mr.A.Karunarathna	Ms. S.Senevirathna

Discussed Matters:

1. Disposal site

- MMC have started dumping at temporary disposal site in Matale PS about 10-12km away from Matale, using pit/cell system. A 10 acre site – if needed, can acquire more land. Doing surveying of boundaries now (Land Reform Commission). Using JCB + bulldozer (900Rs/h).
- Matale PS had meeting today and discussed about landfilling at this site. Agreed to form monitoring committee, with Mayor, MOH, CPHI as MMC reps + PS Env Officer + 5 people from area (residents along road). PS supports landfill and wants to use it as well.

2. Waste Collection Improvements

- Noticeboards: all 100 now built, but only 40 filled with words. Will possibly keep some in stores for adding words later.
- Litter bins: to spray paint plastic litter bins + put holes in bottom for drainage.
- Trash/mobile litter bins: to install by 5th Sep.
- Transfer ramp: contractor wants to start construction this week at Park Ln and Gongawela market. Can do construction within budget price.
- White compactor – S/A fitted; start fixing noticeboards from Wed; also do loudspeaker announcement then; start bell collection from Thurs (some delay due to having to clear backlog of garbage due to disposal site issues).
- Green compactor – now fixed (clutch plates now available in SL). One bell collection area revised to account for change of disposal site – Muslim town, Rattota Rd and Mandandawela.

3. Environmental Education Centre

- Opening ceremony for EEC after 16 Sep.

4. Other

- Control board – Ms. Oishi to discuss with CPHI.
- 23 Oct for 2nd seminar.
- Nature Care coming for meeting with Mayor next week: want to charge 75,000Rs/mth + 2M Rs loan for construction.
- New commissioner (from AG office) has started work: not experienced in local government; his priorities are tax collection first, SWM second and city beautification 3rd.

Interested in SWM, as had to deal with many SWM issues while at AG office.

MMC / JICA Progress Meeting

Date: September 26, 2003

Participants:	MMC	JICA		
	MOH, CPHI	Mr A.Doi	Dr. S. Finnigan	Ms. N.Samarawera
		Ms. M.Oishi	Ms. T. Kitajima	Mr.R.Kuruppuge
		Ms. S.Senevirathna		

Discussed Matters:

1. Bell collection inspection

JICA team did a field inspection of the bell collection system in action, accompanied by the MOH, CPHI, supervisors and the Commissioner. This was followed by a meeting with the MOH and CPHI to discuss progress.

2. Bell collection

- This started in Kotuwegedera on 28 August, followed by expansion to Hulangamuwa and Dodandeniya today. It should start in Muslim town next week. MMC marked collection times and dates on noticeboards for this area and distributed leaflets in Tamil yesterday.
- Another S/A is not working.

3. Motorcycles

- These are being used. One each has been assigned to supervisors in the bell collection area, MC Rd area, MC/office area. The fourth is being kept as a spare at the office for common use.

4. Litter bins

- Movable litter bins have been placed at parks, library and bus stand.
- Some trash bins have been fixed in Prince St.
- School litter bins to be introduced as part of planned school programme.

5. Modified Handcarts

- Waiting for holes to be made in plastic buckets before starting.

6. Stationary Trailers

- Now in use at Gongawela market and Park Lane.
- Ramp: this has been made too steep due to contractor error – it is to be redone.

7. Waste minimization

- MMC to try and coordinate/integrate traditional recycling system with the Sevenatha source separation system in MC Rd area.

8. Landfill

- Due to public protests at new site, MMC organized public meeting at local temple. Attended by Chief Minister. Problems were resolved and they are continuing to use this site.
- One supervisor is to be assigned to the landfill.

9. EEC

- This will be used for the first time on Sep 29th for MMC meeting.
- DEO assigned to look after the EEC. He will train an assistant.

10. Other

- MMC hope to start using the monthly report and control board from Oct 1. Meeting with supervisors planned for Sep 29th to discuss these issues.

4.2 Current market status

4.2.1 Price of basic construction materials, consumables and services in current market.

Prior to estimate SMW projects cost, JICA Study team had been surveyed several price which related to Solid Waste Management.

Basic cost for construction materials, consumables and services in current market are shown in Table 4-1, Table 4-2.

Table 4-1: Current market price of construction materials and consumables.

Item No	Description	Unit	Rate (Rs)
1	Basic Construction Materials		
	Cement (Bag)	Per bag	460
	Course Aggregate (0-40mm)	Cum	1,500
	Rubble	Cum	1,230
	Sand (River or Mining)	Cum	1,390
	Ready mixed concrete (Fck 200kg/cm ² or equivalent)	Cum	8,600
	Reinforcement Bar	Tonne	84,000
	Mild Steel	Tonne	76,800
	High Tensile Steel	Tonne	80,000
	Timber (Hard Wood for Structure)	Ton or Cum	35,000
	Premixed Asphalt	Ton	3,840
	Concrete Pipe (D=150mm)	M	660
	Concrete Pipe (D=300mm)	M	720
	Concrete Pipe (D=450mm)	M	900
	Perforate Concrete Pipe (D=150mm)	M	1,980
	Perforate Concrete Pipe (D=300mm)	M	2,160
	Perforate Concrete Pipe (D=450mm)	M	3,000
2	Consumables		
	Gasoline	Litter	55
	Diesel oil	Litter	35
	Hydraulic Oil	Litter	130
	Engine Oil	Litter	125

Note: All prices were surveyed by JICA Study Team on August 2003

Table 4-2: Current market prices of several services

Item No	Description	Unit	Rate (Rs)
1	Personal Cost		
	Manager	Man/Month	35,000
	Engineer	Man/Month	28,750
	Supervisor	Man/Month	25,000
	Machinery Operator	Man/Month	18,000
	Mechanic	Man/Month	15,000
	Collection Worker	Man/Month	10,000
	Watchman	Man/Month	10,000
2	Machinery Rental Cost (with operator)		
	Lorry (10ton)	No/day	11,520
	Lorry (8ton)	No/day	9,600
	Lorry (4ton)	No/day	7,200
	Lorry (2ton)	No/day	6,240
	Case Machine (JCB)	No/day	11,520
	Excavator (Bucket capacity 0.1 m3)	No/day	6,240
	Excavator (Bucket capacity 0.4 m3)	No/day	11,420
	Excavator (Bucket capacity 0.7 m3)	No/day	18,240
	Bulldozer (Class D4)	No/day	12,960
	Bulldozer (Class D6)	No/day	24,000
	Tractor	No/day	2,400
	Vibration Compactor (Handy type)	No/day	2,500
	Vibration Compactor (Machine weight 2 to 4 ton)	No/day	9,600
	Vibration Compactor (Machine weight 10 ton)	No/day	14,600

Note: All prices are surveyed by JICA Study Team on August 2003

Personal costs are included in the cost, such as Employee's pension, workman's insurance and other expenses related to the works.

4.2.2 Equipment cost and lifetime for storage and discharge of waste.

Equipment cost and lifetime for storage and discharge of waste are shown in Table 4-3

Table 4-3: Equipment cost for storage and discharge of waste

Item No	Description	Unit	Rate (Rs)	Estimated Lifetime (Year)
1	Collection Item			
	Street Litter bin (Basket type)	No	1,500	2 ~ 3
	Street Litter Bin (Fixed half dram type)	No	1,300	2 ~ 3
	Street Litter Bin (movable half dram type)	No	1,700	2 ~ 3
	Litter Bin (Concrete type)	No	900	4 ~ 5
	Plastic Bucket (30 litter)	No	370	N/A
	Plastic Bucket (40 litter)	No	490	N/A
	Plastic Bucket (50 litter)	No	500	N/A
	Plastic Basket Litter Bin (20 litter)	No	90	N/A
	Plastic Basket Litter Bin (30 litter)	No	130	N/A
	Plastic Basket Litter Bin (50 litter)	No	495	N/A
2	Disposal Item			
	Plastic Bag (Medium)	Pcs	3	N/A
	Plastic Bag (Large)	Pcs	4	N/A

Note: All prices are surveyed by JICA Study Team on August 2003

4.2.3 Equipment cost for Collection and Transport of waste

Equipment cost for collection and transport of waste are shown in Table 4-4

Table 4-4: Estimated Equipment cost for collection and transport of waste

Item No	Description	Machinery cost (Rs)	O&M Cost (per year)			Estimated Life Time (Year)	Specification
			<i>Repairing</i>	<i>Fuel, oil</i>	<i>Operator</i>		
1	Tractor	1,200,000	200,000	600,000	150,000	6~8	4ton(Japan)
	Trailer (Open type)	200,000	50,000	N/A	N/A	3~4	
	Trailer (with cover type)	250,000	70,000	N/A	N/A	3~4	
	Compactor track	7,000,000	400,000	800,000	180,000	8~10	
	Skipper track	2,600,000	300,000	800,000	180,000	8~10	
	Skip container	300,000	50,000	N/A	N/A	3~4	
	Lorry	1,900,000	200,000	600,000	150,000	8~10	2ton(Japan)
	Lorry	2,700,000	300,000	600,000	150,000	8~10	4ton(Japan)
	Dumper Lorry	2,500,000	400,000	1,800,000	200,000	6~8	10ton(India)
	Bulldozer	6,800,000	600,000	1,200,000	220,000	8~10	D4 class
	Case Machine	4,800,000	400,000	1,200,000	220,000	10~15	JCB
	Excavator	7,800,000	700,000	1,800,000	220,000	7~8	Bucket Capacity 0.7m3

Note: All prices are surveyed by JICA Study Team on September 2003

All of machinery costs are bland-new price in Sri Lanka.

4.3 Prototype SWM projects

4.3.1 Categorization of SMW projects

Landfill may have different type of categorizations 1) Based on Topography of the project area, 2) Based on Amount of Daily waste generation etc. The study team shall be used “Based on amount of daily waste generation” it would be much familiar for person in charge of SWM.

The categorization is as follow;

Small Size Landfill	Daily waste generation	~ 10 ton/day
Medium Size Landfill	Daily waste generation	10 ton/day ~ 40 ton/day
Large Size Landfill	Daily waste generation	40 ton/day ~

Generally Life time of Plant will be design about 15 ~ 20 years except small size landfill. The reasons are

- 1) Take long time to obtain approval and permission from relevant authorities. It would be take about 3 years.
- 2) Initial investment cost (Construction cost, Machinery purchase cost etc.) is high. Therefore if life time is designed short period, depreciation cost would be very high.

4.3.2 Small Size Landfill

4.3.2.1 Method of small sanitary landfill

The trench method of landfill is suited to the area where an adequate amount of cover material is available at the site and where the water table is not near to the surface. Typically, solid wastes are placed in trenches excavated in the soil. The soil excavated from the site is used for daily and final cover. The trenches vary from 30 to 100m in length, 1 to 2m in depth and 2 to 3m in width.

Characteristics are

- Not required big space
- Amount of disposed waste is a little therefore leachate treatment is not required.
- Not required heavy machinery (Bulldozer)
- Easy management

4.3.2.2 Budgetary cost for small size sanitary landfill

a. Initial Investment Cost

Not required.

b. Operational and Maintenance Cost

Average cost of O&M as following;

Table 4-5: Average cost of O&M for Small Size Landfill

Unit: Per 100 ton

Description	Unit	Q'ty	Amount (Rs)	Remarks
Workmanship and Machinery cost	Ls	1	25,000 ~ 35,000	Excavation of trench and soil cover
Total	ton	100	25,000 ~ 35,000	

Generally O&M cost will be about range from **250 Rs/ton to 350 Rs/ton** and Costs are mainly labour salary and machinery rental cost.

4.3.3 Medium Size Landfill

4.3.3.1 Method of medium size landfill

There are two type of medium size of landfill. One is Slope landfill which waste is placed along the sides of existing hill slope. The other one is waste is placed in valley, canyons, borrow pit. Extent landfill volume will be 55,000 to 290,000 ton. Reasonable height of landfill is range from 10 to 20m high

Heavy machinery is required for laying of waste and daily soil cover.

Characteristics are

- A large volume of waste will be disposed.
- Required leachate treatment facility
- Accessible of big waste collection vehicle.
- Required bulldozer (Laying of waste, daily cover of soil)

4.3.3.2 Budgetary cost for Medium Landfill

a. Initial Investment cost

Estimated initial cost for Medium size landfill is as following;

Table 4-6: Initial investment cost for Medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Pre-Construction				
Investigation	Ls	1	300,000 ~ 500,000	
Design	Ls	1	500,000 ~ 900,000	
Machinery Purchase	no	1	7,000,000	Bulldozer (D4 class)
Construction				
Leachate collection	Ls	1	1,600,000 ~ 2,000,000	
Leachate Treatment	Ls	1	1,300,000 ~ 1,500,000	
Gas Ventilation	Ls	1	30,000 ~ 50,000	
Storm Water Drainage	Ls	1	70,000 ~ 150,000	Surrounding of waste pile
Administration	Ls	1	2,500,000	Control House etc
Security facilities	Ls	1	650,000 ~ 1,200,000	
Access Road	Ls	1	600,000 ~ 1,200,000	
Gully sacker	Ls	1	1,000,000	
Healthcare waste pit	Ls	1	1,350,000	
Others	Ls	1	300,000 ~ 400,000	
Total			17,200,000 ~ 19,750,000	

Note: Cost is estimated based on existing ground have impervious soil (Permeability is less than 10-5cm/sec). Therefore if existing soil does not comply the requirement, Membrane sheet will be required. (Cost is 5,000 Rs/sq.m)

Generally required initial cost for medium size landfill is range about from **100Rs/ton to 300Rs/ton**.

b. Operation and Maintenance Cost

Estimated initial cost for Medium size landfill is as below.

Table 4-7: O&M cost for medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Operational Cost				
Manpower Cost	Ls	1	11,500,000 ~ 19,000,000	Supervisor, labour, security machine operator etc.
Maintenance Cost				
Material Cost	Ls	1	1,500,000 ~ 2,000,000	Turf, Gas Ventilation pipe etc.
Machinery Cost	Ls	1	1,000,000 ~ 1,800,000	Fuel, Oil, Spare parts
Total			14,000,000 ~ 22,800,000	

Generally required O&M cost for medium size landfill are range about from **250Rs/ton to 400Rs/ton**.

4.3.4 Large size landfill

4.3.4.1 Method of medium size landfill

Type of filling is same as medium size landfill extent landfill waste volume would be more than 3,000,000 ton.

It is required at least 25,000sq.m to 30,000sq.m open area in valley, canyons, or borrow pit.

Characteristics are

- A large volume of waste will be disposed.
- Required leachate treatment facility
- Accessible of big waste collection vehicle.
- Required plural number of bulldozers (Laying of waste, daily cover of soil)

4.3.4.2 Budgetary cost for Medium Landfill

a. Initial Investment cost

Estimated initial cost for Medium size landfill (generation of waste volume from 50 ton/day to 100 ton/day) is as below.

Table 4-8: Initial investment cost for Medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Pre-Construction				
Investigation	Ls	1	600,000 ~ 900,000	
Design	Ls	1	1,200,000 ~ 1,700,000	
Machinery Purchase	no	2	14,000,000	Bulldozer (D4 class)
Construction				
Leachate collection	Ls	1	2,600,000 ~ 3,900,000	
Leachate Treatment	Ls	1	1,500,000 ~ 2,000,000	
Gas Ventilation	Ls	1	50,000 ~ 100,000	
Storm Water Drainage	Ls	1	150,000 ~ 300,000	Surrounding of waste pile
Administration	Ls	1	4,100,000	Control House etc
Security facilities	Ls	1	2,300,000 ~ 4,000,000	
Access Road	Ls	1	1,650,000 ~ 2,000,000	
Gully sacker	Ls	1	1,650,000 ~ 2,000,000	
Healthcare waste pit	Ls	1	2,500,000 ~ 3,500,000	
Others	Ls	1	700,000 ~ 1,500,000	
Total			33,000,000 ~ 40,000,000	

Note: Cost is estimated based on existing ground have impervious soil (Permeability is less than 10-5cm/sec). Therefore if existing soil does not comply the requirement, Membrane sheet will be required. (Cost is 5,000 Rs/sq.m)

Generally required initial cost for medium size landfill is range about from **60Rs/ton to 100Rs/ton**.

b. Operation and Maintenance Cost

Estimated initial cost for Medium size landfill (generation of waste volume from 50 ton/day to 100 ton/day) is as below.

Table 4-9: O&M cost for medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Operational Cost				
Manpower Cost	Ls	1	23,000,000 ~ 29,000,000	Supervisor, labour, security machine operator etc.
Maintenance Cost				
Material Cost	Ls	1	5,000,000 ~ 8,000,000	Turfing, Gas Ventiration etc.
Machinery Cost	Ls	1	22,000,000 ~ 27,000,000	Fuel, Oil, Spare parts
Total			50,000,000 ~ 64,000,000	

Generally required O&M cost for medium size landfill is range about from 110Rs/ton to 180Rs/ton.

4.3.5 Aptness of Initial and O&M cost against Capacity of landfill

Figure 4-1 shows aptness of initial and O&M cost against carrying in waste.

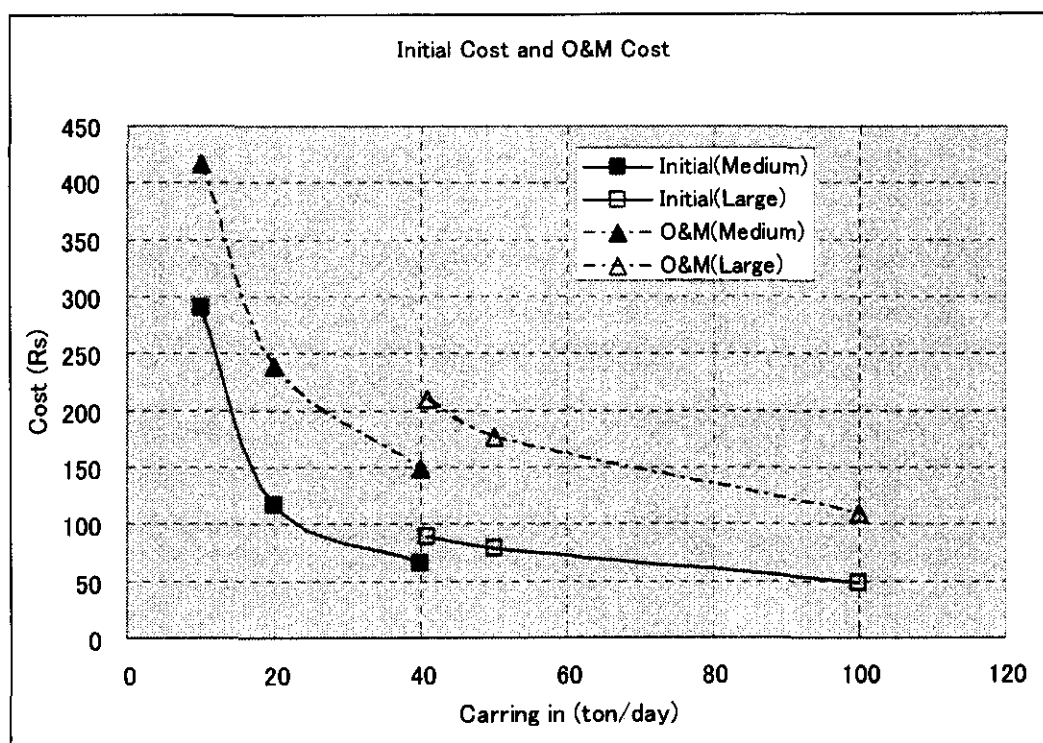


Figure 4-1: Initial cost against Generation

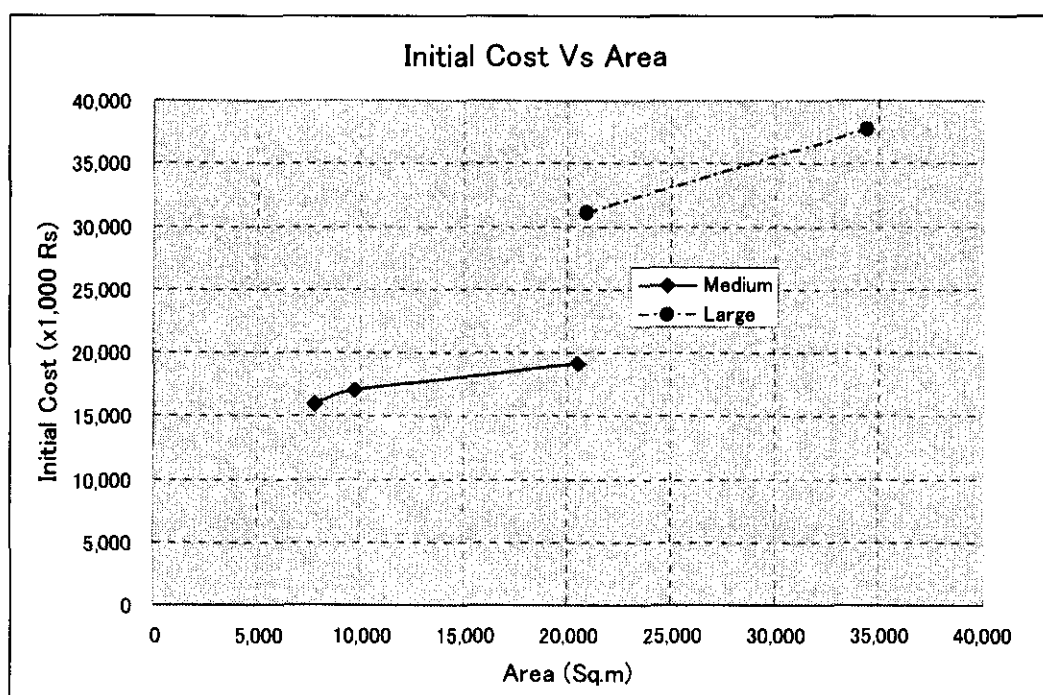


Figure 4-2: Initial cost VS Landfill area

According to Figure 4-1 and Figure 4-2, when increasing of carrying in waste, the total cost is decreasing. Initial cost is increasing pro rata with project area. It is not depending on volume of carrying in waste. Therefore initial cost ratio is depending of height of received waste.

O&M cost is related with amount of carrying in waste, however it is almost constant with carrying in volume up to 40 ton/day. This means the same party will be able to operate up to 40ton/day over the volume 40 ton/day another operation party will be required.

4.3.6 Compost plant

Solid Waste Compost is defined as the bioconversion of waste into amorphous dark brown to black colloidal humus like substance under the conditions of optimum temperature, moisture and aeration.

If composting system use at same time with sanitary landfill, it is results to reducing of carrying in waste to the landfill site and it makes lifetime longer for landfill site.

Composting systems are categorized based on method of handling and aeration method.

- Static Pile Composting system
- Windrow Composting system
- In Vessel Composting system

4.3.6.1 Static pile composting system

The system does not required high level of technical skill for operation and maintenance.

Estimated project costs are as followings,

Table 4-10: Project cost for static pile composting system (Capacity 6 ton/day)

Description	Unit	Q'ty	Amount (Rs)	Remarks
Initial cost				
Construction	Ls	1	500,000 ~ 1,000,000	
Operational Cost	Year	1	400,000 ~ 500,000	Supervisor, labour, security etc.
Maintenance Cost	Year	1	50,000 ~ 100,000	

Note: Cost does not included Land acquisition cost

Table 4-11: Unit cost for static pile composting system

Description	Unit	Q'ty	Amount (Rs)
Initial cost	Year	1	25,000 ~ 50,000
Operational cost	Year	1	400,000 ~ 500,000
Maintenance Cost	Year	1	50,000 ~ 100,000
Total	ton	1,800	475,000 ~ 650,000
	ton	1	260 ~ 360

Note: Assuming initial investment cost amortize over a period of 20 years

The above cost does not included disposal of residue. The residue would generate 800kg from 1000kg of waste.

The product would be having commercial value of 2Rs/kg in market.

Example: Katana Compost Facility (Improved static pile system)

4.3.6.2 Windrow composting system

Generally manual mixing or mechanical mixing with machine, the system required some level of technical knowledge for construction and maintenance.

Estimated project costs are as followings,

Table 4-12: Project cost for windrow composting system (Capacity 6 ton/day)

Description	Unit	Q'ty	Amount (Rs)	Remarks
Initial cost				
Construction	Ls	1	1,000,000 ~ 2,000,000	
Operational Cost	Year	1	400,000 ~ 500,000	Supervisor, labour, security etc.
Maintenance Cost	Year	1	30,000 ~ 50,000	

Note: Cost does not included Land acquisition cost

Table 4-13: Unit cost for windrow composting system

Description	Unit	Q'ty	Amount (Rs)
Initial cost	Year	1	50,000 ~ 100,000
Operational cost	Year	1	400,000 ~ 500,000
Maintenance Cost	Year	1	30,000 ~ 50,000
Total	ton	1,800	480,000 ~ 650,000
	ton	1	260 ~ 360

Note: Assuming initial investment cost amortize over a period of 20 years

The above cost does not included disposal of residue. The residue would generate 800kg from 1000kg of waste.

The product would be having commercial value of 2Rs/kg in market.

Example: Chilaw compost facility (Manual mixing)

4.3.6.3 In Vessel Composting system

The system required high level of technical knowledge for construction and middle level technical skill for maintenance and operation.

Estimated project costs are as following,

Table 4-14: Project cost for vessel composting system (Capacity 6~8 ton/day)

Description	Unit	Q'ty	Amount (Rs)	Remarks
Initial cost				
Construction	Ls	1	2,000,000 ~ 5,000,000	
Operational Cost	Year	1	700,000 ~ 900,000	Supervisor, labour, security etc.
Maintenance Cost	Year	1	70,000 ~ 100,000	

Note: Cost does not included Land acquisition cost

Table 4-15: Unit cost for vessel composting system

Description	Unit	Q'ty	Amount (Rs)
Initial cost	Year	1	100,000 ~ 250,000
Operational cost	Year	1	700,000 ~ 900,000
Maintenance Cost	Year	1	70,000 ~ 100,000
Total	ton	2,100	870,000 ~ 1,250,000
	ton	1	420 ~ 600

Note: Assuming initial investment cost amortizes over a period of 20 years and production of compost will be 7 ton/day.
The above cost does not included disposal of residue. The residue would generate 800kg from 1000kg of waste.
The product would be having commercial value of 2Rs/kg in market.

Example: Inclined step grated composting system (University of Peradeniya)

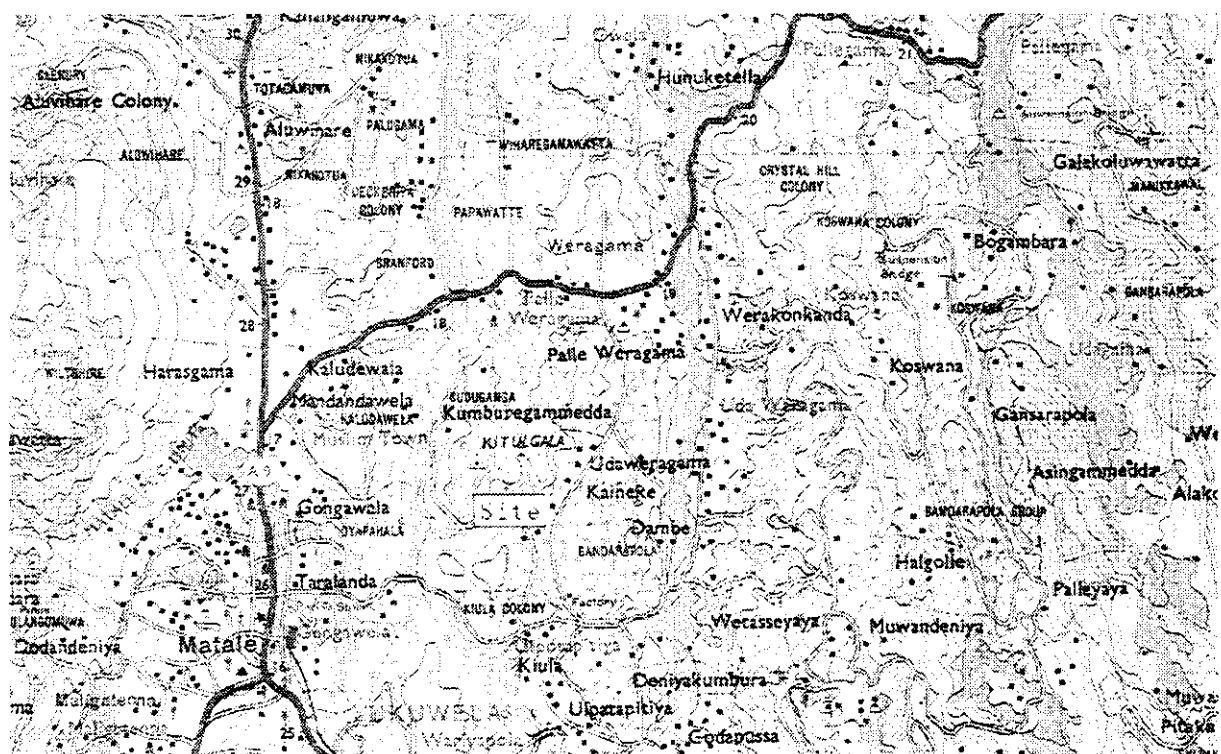
4.4 SWM project cost and details for Matale MC Project

4.4.1 Location of the Saduganga Landfill Site

The project site is located in Suduganga Estate, about 3 km east to Matale Town.

About 300 meters to the west runs the Sudu River, but between project site and Sudu River located a hill named as Sudugangawatta.

Suduganga Estate used as rubber and other forest plantation until 1980s, but the plantation has been abandoned for more than 10 years, and then no any other kind of development was planned and/or implemented. There is no existing rubber tree in the project site, and the feature of the land in the project site should be categorized into natural forest rather than forest plantation.



4.4.2 Sanitary Landfill Facility for Saduganga Landfill Site

4-30

Table 4-16: Conceptual Design of improved Saduganga Landfill Site

Item		unit	Qty
Total domain of Matale council		ha	Approx. 2.77
Total area of improved landfill site		ha	Approx. 2.2
Extent Capacity		m ³	162,000
Life span		year	16
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)	L.S.	1
Sanitary waste disposal facility	Access road (asphalt paved) for long term use	L.S.	1
	Access road (gravel) for short term use	L.S.	1
	Fence (Movable type)	L.S.	1
	Foundation wall	L.S.	1
	Retaining wall	L.S.	1
Leachate collection facility			
-Perforated drainage with crushed stone		L.S.	1
-Bed rock as natural liner instead of artificial liner			
Leachate treatment facility	Conditioning pond	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	L.S.	1
	Earth drain type along the road	L.S.	1
Gas ventilation facility –Perforated oil barrel filled with rubble stone		nos.	8
Disposal pit for infectious waste		no.	1

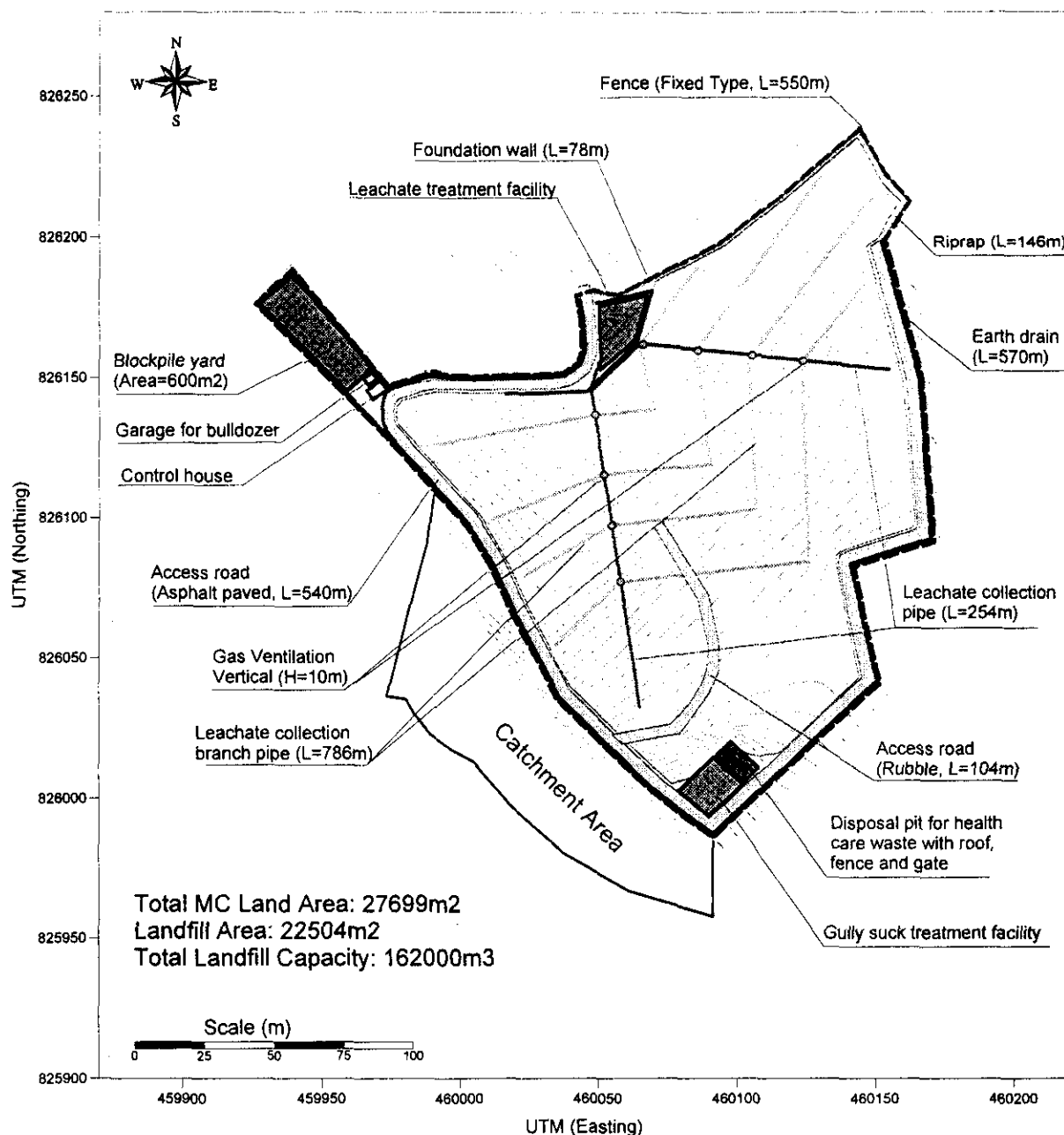


Figure 4-4: Facility plan of improved Saduganga Landfill Site

4.4.3 Main Facilities detail

4.4.3.1 Leachate Collection System

In order to avoid the contamination of grand 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 comply with the requirement, artificial liner shall be used to prevent 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 instead 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 4-4 and sectional detail is shown in Figure 4-5 and Figure 4-6.

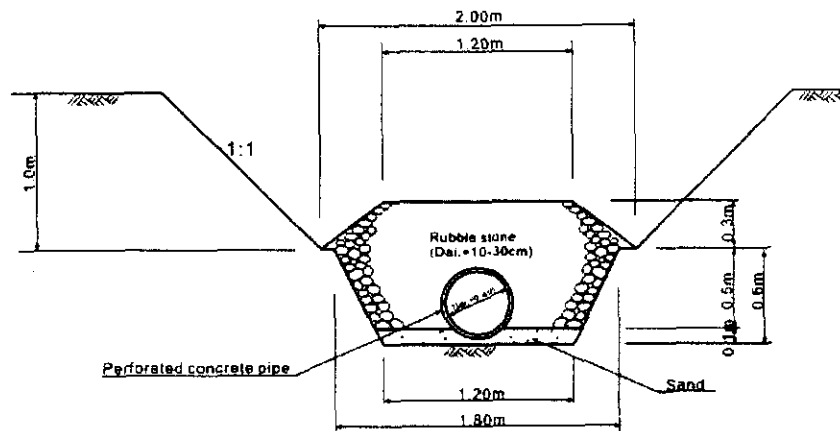


Figure 4-5: Section of Main Leachate Collection Pipe

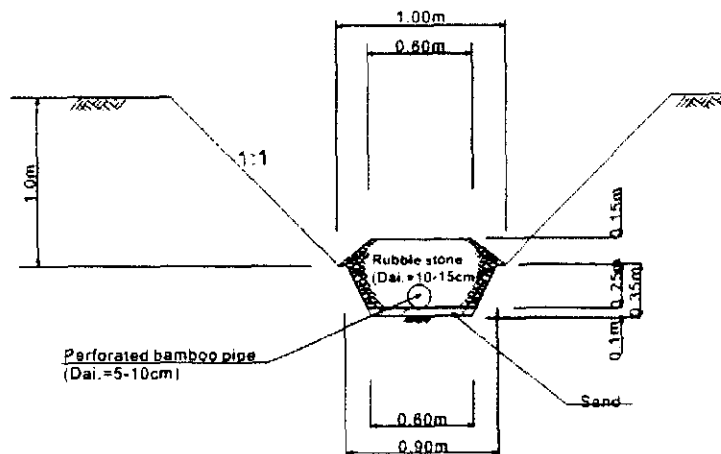


Figure 4-6: Section of Leachate Collection Branch Pipe.

4.4.3.2 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 Matale project.

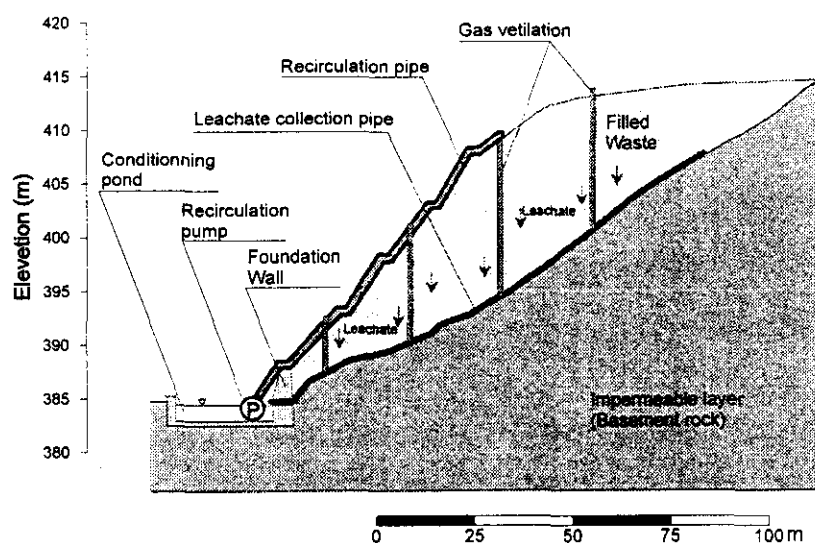


Figure 4-7: Sketch of Leachate Treatment Facility

4.4.3.3 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)

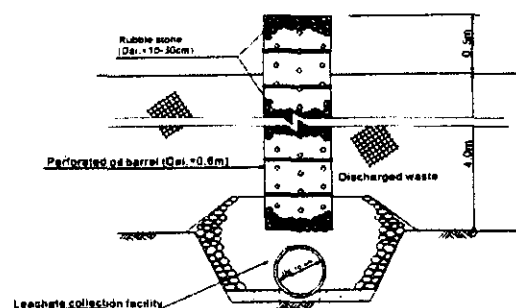


Figure 4-8: Gas Ventilating Facility

4.4.3.4 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.

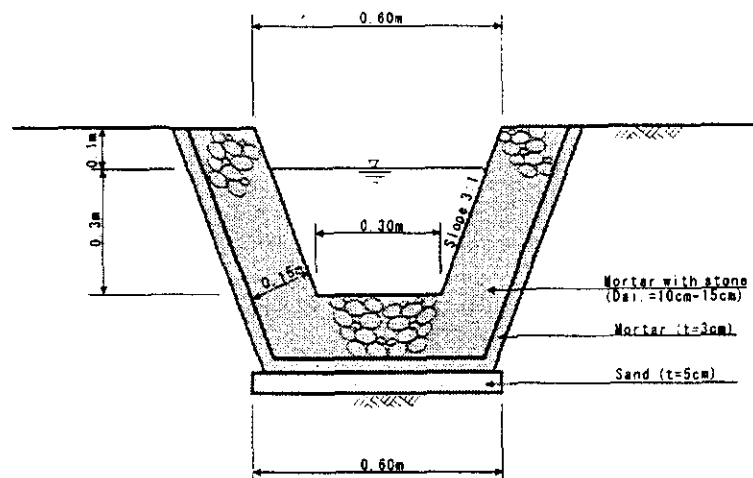


Figure 4-9: Riprap Lined Storm water Drain

4.4.4 Details of other structure

4.4.4.1 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.

4.4.4.2 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.

4.4.4.3 Fence (movable type)

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

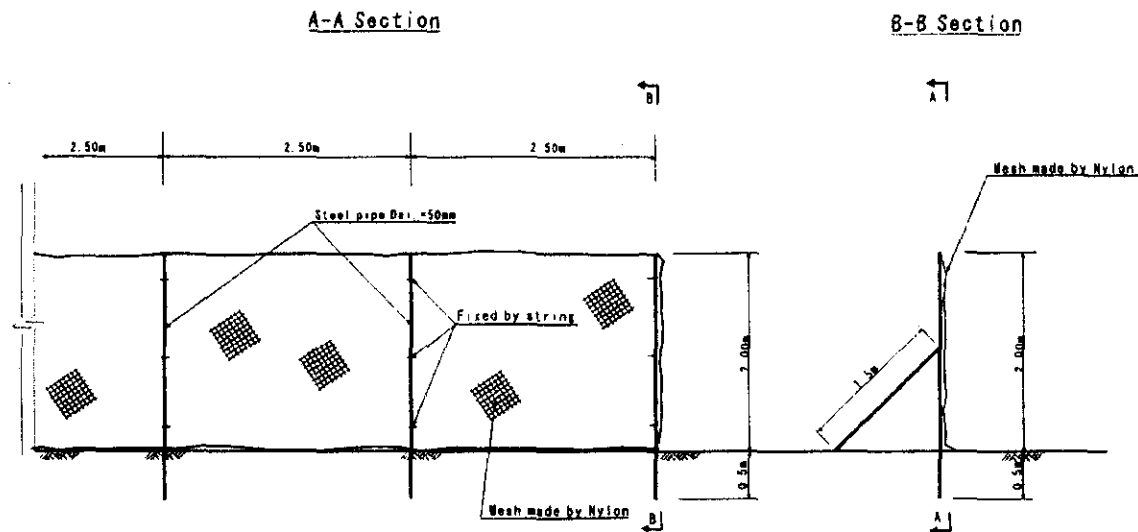


Figure 4-10: Fence (movable type)

4.4.4.4 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.

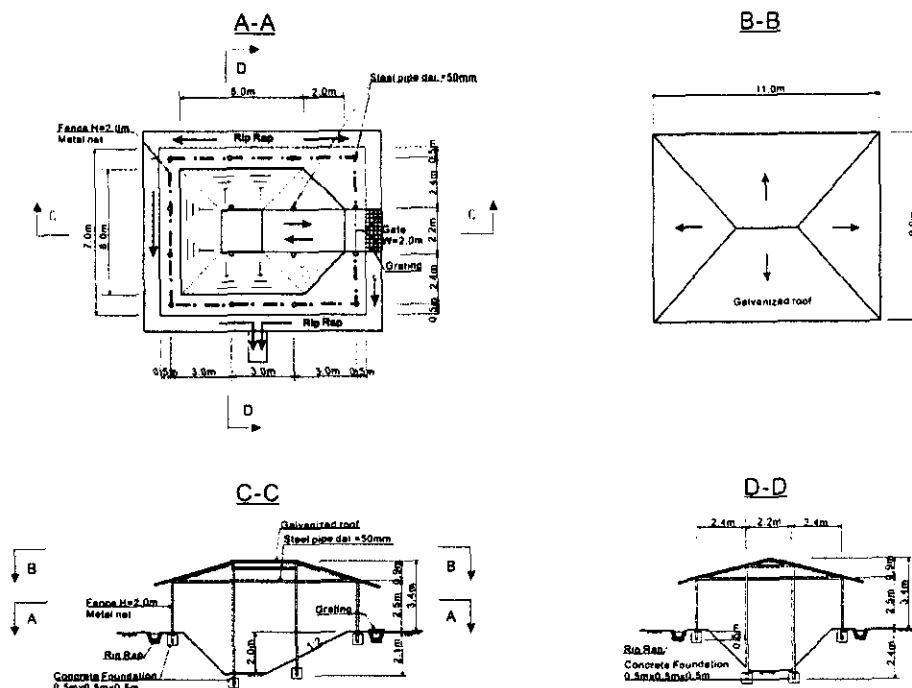


Figure 4-11: Disposal Pit for Healthcare Waste

4.4.4.5 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.

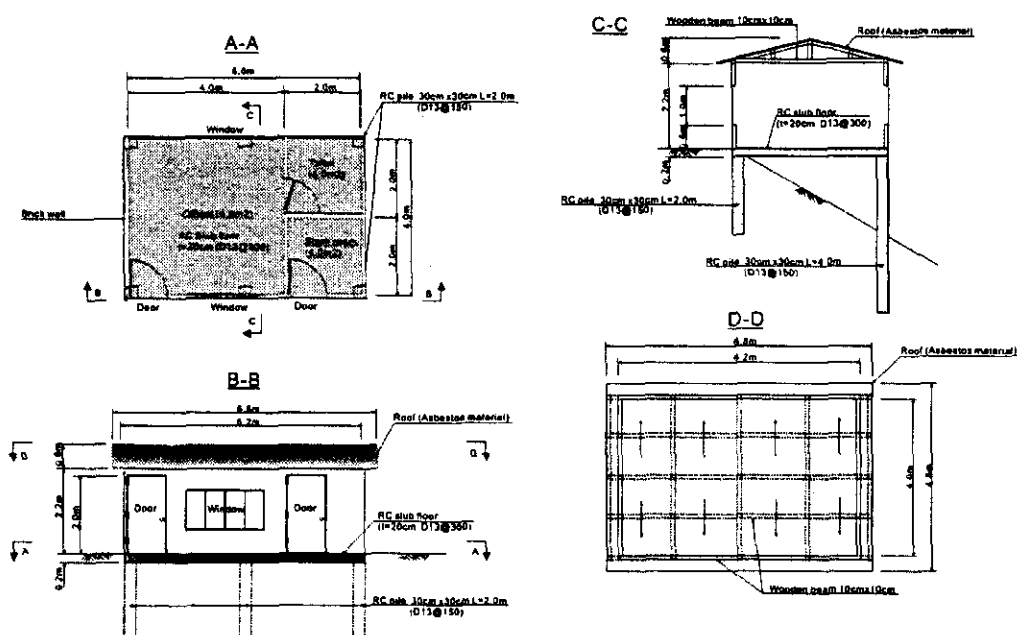


Figure 4-12: Administrative Facilities

4.4.4.6 Security facilities

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

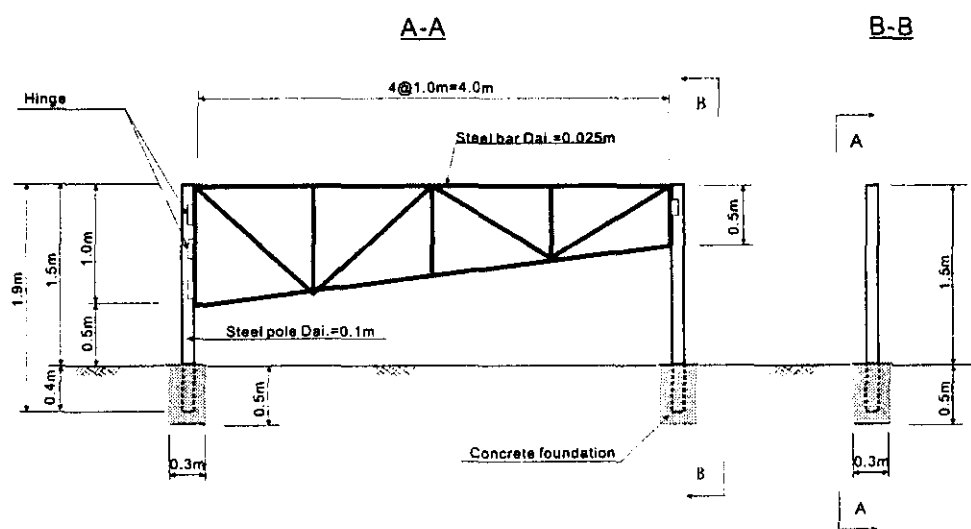


Figure 4-13: Gate

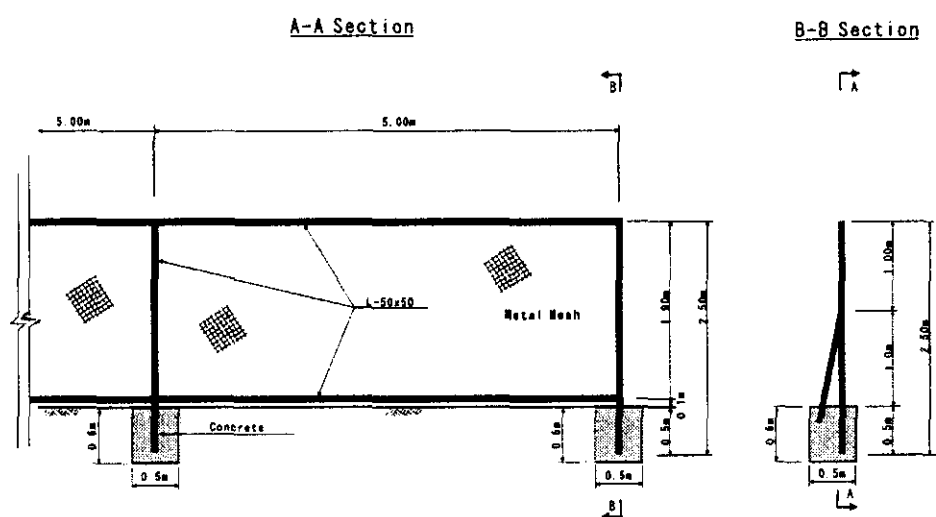
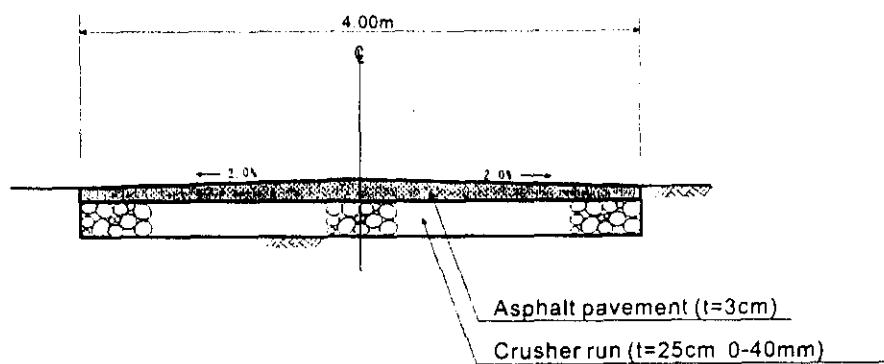


Figure 4-14: Fence (fixed type)

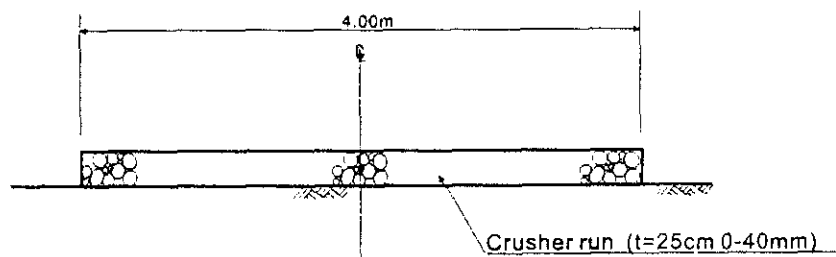
4.4.4.7 Access road

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 year of waste collection vehicles and to reduce the repairing cost.

The following two types of access roads shall be provided.



Asphalt paved Road



Gravel Road

Figure 4-15: Typical Cross Section of Access Road

4.4.5 Initial investment cost and O&M cost

4.4.5.1 Initial Investment Cost of improved Saduganga landfill

Based on facility plan of improved Saduganga landfill, initial investment cost is summarised in Table 4-17.

Table 4-17: Initial investment cost for Saduganga Landfill

	Description		Unit	Q'ty	Rate	Amount (Rs)
Pre-Construction Cost						
Soil investigation Fees	Soil strata, Permeability		Ls	1.00	303,700	303,700
Land Survey	Topography, Sectional		ha	2.80	61,600	172,480
Detail Design Fees	Structure Design	5% of Construction cost	Ls	1.00	529,000	529,000
Application Fees for Authorities			Ls	1.00	100,000	100,000
Purchasing of Bulldozer	D4 class		Ls	1.00	6,800,000	6,800,000
Sub Total			ton	114,464	69.06	7,905,180
Construction Cost						
Site Clearing, Logging Tree			ha	3	100,000	280,000
Administration	Control office		no	1	1,450,000	1,450,000
	Garage for Bulldozer		no	1	1,080,000	1,080,000
Security and safety facility	Fence	Fixed	m	550	1,600	880,000
	Gate		no	1	17,900	17,900
Sanitary waste disposal facility	Access road	Gravel	m	104	860	89,440
		Asphalt Pavement	m	540	1,400	756,000
	Fence	Movable	m	32	1,600	51,200
	Foundation Wall		m2	205	2,000	409,500
Leachate Collection Facilities	Retaining wall		m2	248	2,800	693,000
	Main Line	Dia 400mm	m	290	1,600	464,000
	Branch Line	Dia 100mm	m	726	800	580,800
Leachate treatment facility	Correction pond	RC structure	no	1	210,000	210,000
	Circulation pump	Head 20m	no	2	284,600	569,200
	Electricity wiring		Ls	1	500,000	500,000
	Circulation pipe		m	80	600	48,000
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		m	35	260	9,100
Gas Vertical Ventilation	Dia 600 mm		m	32	1,200	38,400
Storm water drainage	Earth Drain		m	570	65	37,050
	Rip rap type		m	146	430	62,780
Disposal pit for Healthcares waste			no	1	1,350,000	1,350,000
Sub Total			ton	114,464	92.40	10,576,370
Total			ton	114,464	161.46	18,481,550

4.4.5.2 Operation and Maintenance cost of improved Saduganga landfill

Operation and maintenance cost is summarised in Table 4-18.

Table 4-18: Operation and Maintenance cost of improved Saduganga landfill

	Description		Unit	Q'ty	Rate	Amount (Rs)
Operational cost						
Supervisor	On / off	50% of salary	m'th	192.00	12,500	2,400,000
Bulldozer operator	Full time		m'th	192.00	18,000	3,456,000
Mechanic	Maintenance for Pump	50% of salary	m'th	192.00	7,500	1,440,000
Foreman	Full time		m'th	192.00	18,000	3,456,000
Security Guard & recorder	Full time		m'th	192.00	10,000	1,920,000
General Labour	3 persons		m'th	576.00	10,000	5,760,000
Sub Total			ton	114,464	161.03	18,432,000
Maintenance Cost						
Material Cost						
Turfing	Closed turfing on the slope		m2	20,000	150	3,000,000
Gas Vertical Ventilation	Extension		m	280.00	1,200	336,000
Miscellaneous			Ls	1		400,000
Machinery Cost						
Fuel and Oil etc	for Bulldozer		m'th	192.00	45,000	8,640,000
Spare parts and repairing	for Bulldozer	5% of M. Value	year	16.00	340,000	5,440,000
Others						
Electricity Consumption			m'th	192.00	10,000	1,920,000
Sub Total			ton	114,464	172.42	19,736,000
Total			ton	114,464	333.45	38,168,000

Initial Investment			ton	114,464	161.46	18,481,550
Operational and Maintenance			ton	114,464	333.45	38,168,000
Grand Total		Per tonnage	ton	114,464	494.91	56,649,550
		Per Year	Year	16	3,540,597	56,649,550

4.4.6 Conclusion and Recommendations

Based on prototype SWM project, Saduganga project is categorised in medium sanitary landfill which total cost range about 300Rs/ton to 500Rs/ton. The proposed project is within a reasonable range.

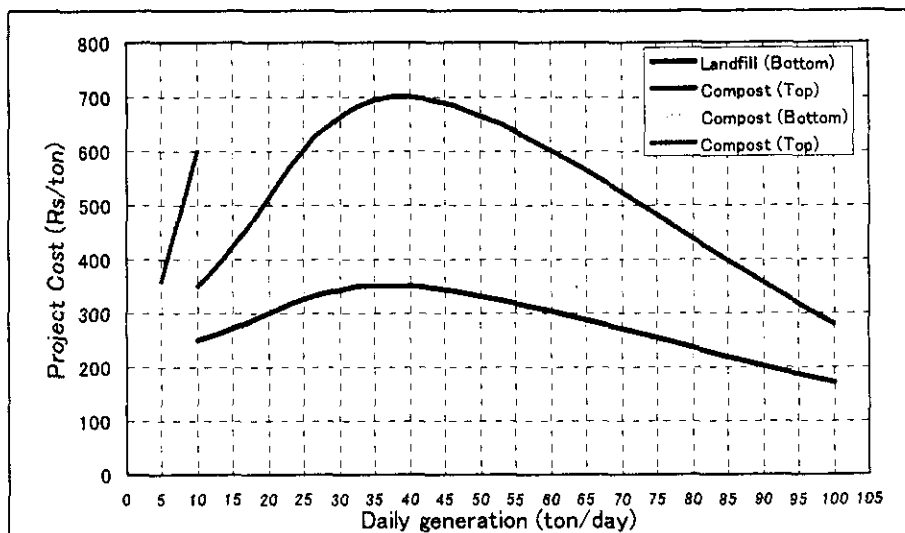


Figure 4-16: Project Cost range

4.5 Geological Survey for The Study on Improvement of Solid Waste management at Matale

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

(Sudugangawatte Site, Owala, Matale)

Client: Kokusai Kogyo. , Co., Ltd.

July, 2003

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Figures

Figure 1: Location of Boreholes

Figure 2a: Profile of sub-surface conditions across
Boreholes BH -05, BH-08 and BH-04

Figure 2b: Profile of sub-surface conditions across
Boreholes BH-01, BH-02, BH-03 and BH-04

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 MATALE

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 Matale, and the site being investigated is Sudugangawatte located at Rattota Road, Owaia.

A contour plan of the area is shown in Fig.1. The site elevations vary between 420 m at the south to 380 m at the north.

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 10 boreholes up to rock or to 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 all 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

The area being investigated is part of a lateritic hillock. It has a total extent of 5 Acres-2 Roods-27.15 Perches.

3. FIELD INVESTIGATIONS

3.1 The Borehole Investigation

The Borehole Investigation consisted of advancing ten boreholes at locations marked BH-01 to BH-10 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.

The following boreholes were terminated before reaching basement rock at a depth of 10.0 m: BH-01, BH-03, BH-04, BH-05, BH-06, BH-08 and BH-10.

Boreholes BH-02, BH-07 and BH-09 were terminated at depths of 5.5 m, 6.5 m and 4.5 m respectively. These boreholes were terminated on reaching a hard surface, which could have either been a core-stone or basement rock.

It is also necessary to indicate that core-stones were found in boreholes BH-03, BH-04 and BH-06 close to the surface. These boreholes were advanced through the core-stones by coring the rock using a double tube core barrel.

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-01. It was determined as the depth at which the water level stabilized inside the borehole.

The Client provided the elevations at the top of boreholes. These elevations together with the depth to hard stratum at each borehole location are given in the table below.

Borehole No.	BH-01	BH-02	BH-03	BH-04	BH-05	BH-06
Elev. at top of borehole (m)	386.29	391.38	402.68	423.07	395.52	396.21
Depth of borehole (m)	10.0	5.5	10.0	10.0	10.0	10.0

Borehole No.	BH-07	BH-08	BH-09	BH-10
Elev. at top of borehole (m)	402.33	404.95	411.28	412.42
Depth of borehole (m)	6.5	10.0	4.5	10.0

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

3.2 Constant Head Field Permeability Tests

Constant Head Field Permeability Tests were carried out in all the boreholes at depths indicated in the table below.

Borehole No.	BH-01	BH-01	BH-02	BH-03	BH-03	BH-04	BH-04	BH-05
Depth of test (m)	2.0	9.0	4.5	2.0	9.0	2.0	9.0	2.0

Borehole No.	BH-05	BH-06	BH-07	BH-07	BH-08	BH-09	BH-10
Depth of test (m)	9.0	9.0	2.0	5.5	9.0	3.5	9.0

In this test, the hole of diameter 2 7/8 inches was cased to the bottom, and the casing tube continued up 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 initially at 5 minute intervals, and subsequently at longer 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 18th to 27th June 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. 2a across boreholes BH-05, BH-08, and BH-04; and
- Fig. 2b across boreholes BH-01, BH-02, BH-03 and BH-04.

These results show that,

- (i) the ground water level (GWL) was at a considerable depth from the surface. It was encountered only at BH-01 at a depth of 7.3m from the surface;
- (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 near the surface in some of the boreholes lying within a matrix of residual material;
- (iii) the depth to basement rock exceeded 10.0m at most of the borehole locations;
- (iv) a hard stratum was found within 10m at a few borehole locations. This could have either been corestones or basement rock.

5. ANALYSIS OF PERMEABILITY TEST RESULTS

The results of the Constant Head Field Permeability Tests are given in Appendix 2.

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

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

where q = constant rate of water intake

F = Intake Factor

H_e = Head causing flow

For the borehole cased to the bottom,

$$F = 2 \times \text{diameter of hole}$$

Specimen calculation for BH-01

Diameter of hole = 0.0762 m

F = 1.922 m

Depth to GWL = 7.3 m

H_e = (7.3 + 1.0) = 8.3 m = 240 cm

From figure of Total Intake vs. Time,

$$q = (6890 - 4350)/20 \\ = 127.0 \text{ cm}^3/\text{min.}$$

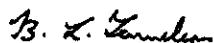
$$k = 7.961 \times 10^{-4} \text{ cm/min.} \\ = 1.327 \times 10^{-3} \text{ cm/sec}$$

Rate of water absorption = $530.5 \text{ cm}^3/\text{min. per sq. m.}$

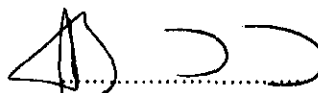
The summary of the results is given in Appendix 3.

6. LABORATORY INVESTIGATIONS

Laboratory tests were carried out on soil samples obtained from close to the surface at locations BH-01, BH-03 and BH-04. These results are given in Appendix 4.



Prof. B. L. Tennekoon
University of Moratuwa



I. M. Jayasinghe
GEOTECH Limited

Appendix 3 – Summary of Analysis of Permeability Test Results

Borehole No. BH-01			
Depth = 2.0 m			
Depth to GWL = 7.3 m			
	k =	1.327E-05	cm/s
	k =	1.327E-07	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 127.0	cm ³ /min	530.5	ml/min.per sq.m
F = 192.2058 cm			
H _c = 830 cm			

Borehole No. BH-01			
Depth = 9.0 m			
Depth to GWL = 7.3 m			
	k =	2.796E-05	cm/s
	k =	2.796E-07	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 322.5	cm ³ /min	1347.2	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-02			
Depth = 4.5 m			
Depth to GWL = Not determined			
	k =	2.825E-05	cm/s
	k =	2.825E-07	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 325.8	cm ³ /min	1361.0	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-03			
Depth = 2.0 m			
Depth to GWL = Not determined			
	k =	5.571E-05	cm/s
	k =	5.571E-07	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 642.5	cm ³ /min	2683.9	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-03			
Depth = 9.0 m			
Depth to GWL = Not determined	k =	2.071E-03	cm/s
	k =	2.071E-05	m/s
k = q / (FH _c)		Rate of water absorption =	
Q = (Q/t) = 23880 cm ³ /min		99753.8 ml/min.per sq.m	
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-04			
Depth = 2.0 m			
Depth to GWL = Not determined	k =	3.772E-05	cm/s
	k =	3.772E-07	m/s
k = q / (FH _c)		Rate of water absorption =	
Q = (Q/t) = 435.0 cm ³ /min		1817.1 ml/min.per sq.m	
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-04			
Depth = 9.0 m			
Depth to GWL = Not determined	k =	8.671E-05	cm/s
	k =	8.671E-07	m/s
k = q / (FH _c)		Rate of water absorption =	
Q = (Q/t) = 510.0 cm ³ /min		2130.4 ml/min.per sq.m	
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-05			
Depth = 2.0 m			
Depth to GWL = Not determined	k =	5.555E-05	cm/s
	k =	5.555E-07	m/s
k = q / (FH _c)		Rate of water absorption =	
Q = (Q/t) = 326.7 cm ³ /min		1364.7 ml/min. per sq.m	
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-05			
Depth = 9.0 m			
Depth to GWL = Not determined			
	k =	1.105E-05	cm/s
	k =	1.105E-07	m/s
k = q / (FH _c)		Rate of water absorption =	
q = (Q/t) = 65.0	cm ³ /min	271.5	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-06			
Depth = 9.0 m			
Depth to GWL = Not determined			
	k =	1.065E-03	cm/s
	k =	1.065E-05	m/s
k = q / (FH _c)		Rate of water absorption =	
q = (Q/t) = 6262.5	cm ³ /min	26160.3	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-07			
Depth = 2.0 m			
Depth to GWL = Not determined			
	k =	2.299E-04	cm/s
	k =	2.299E-06	m/s
k = q / (FH _c)		Rate of water absorption =	
q = (Q/t) = 1352.0	cm ³ /min	5647.7	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

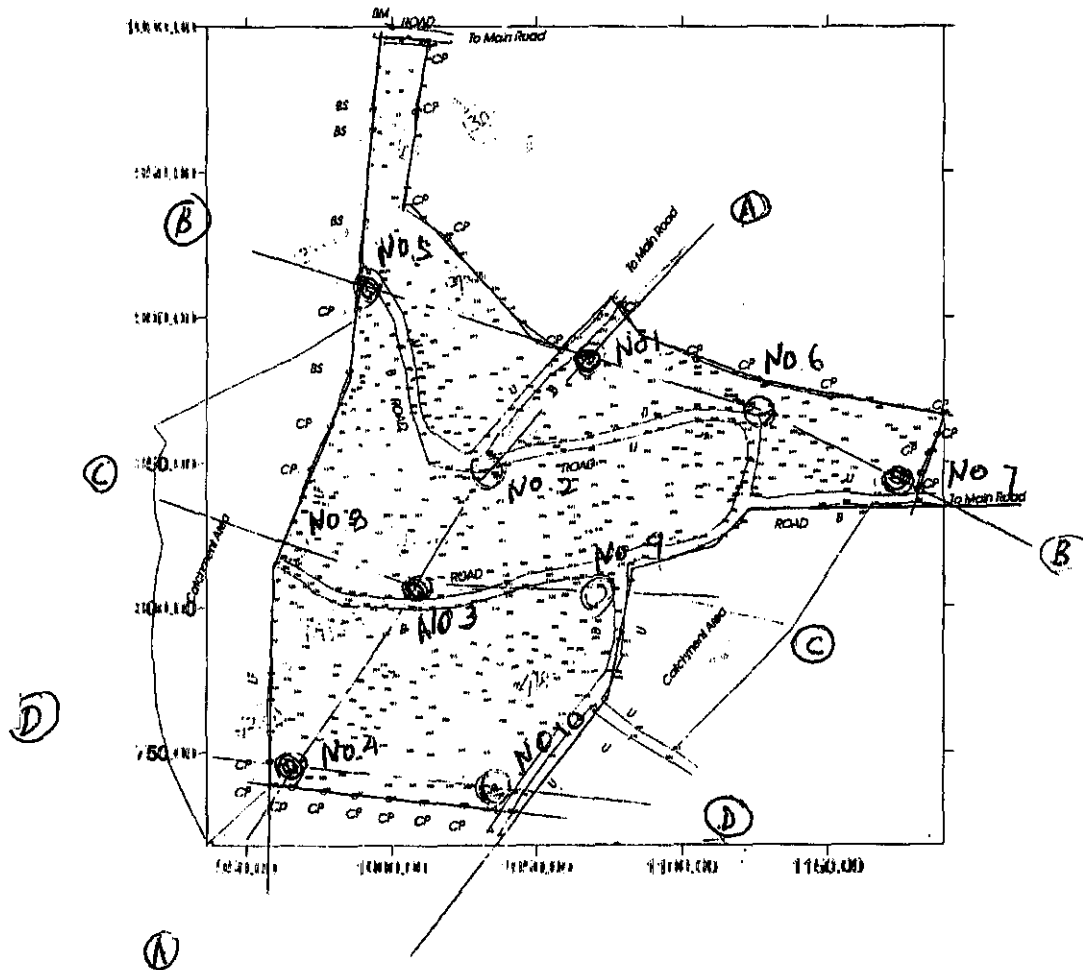
Borehole No. BH-07			
Depth = 5.5 m			
Depth to GWL = Not determined			
	k =	2.389E-05	cm/s
	k =	2.389E-07	m/s
k = q / (FH _c)		Rate of water absorption =	
q = (Q/t) = 140.5	cm ³ /min	586.9	ml/min.per sq.m
F = 192.2058 cm			
H _c = Not determined			

Borehole No. BH-08			
Depth = 9.0 m			
Depth to GWL = Not determined	k =	3.400E-05	cm/s
	k =	3.400E-07	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 200.0	cm ³ /min	835.5	ml/min.per sq.m
F = 192.2058 cm			
H _o = Not determined			

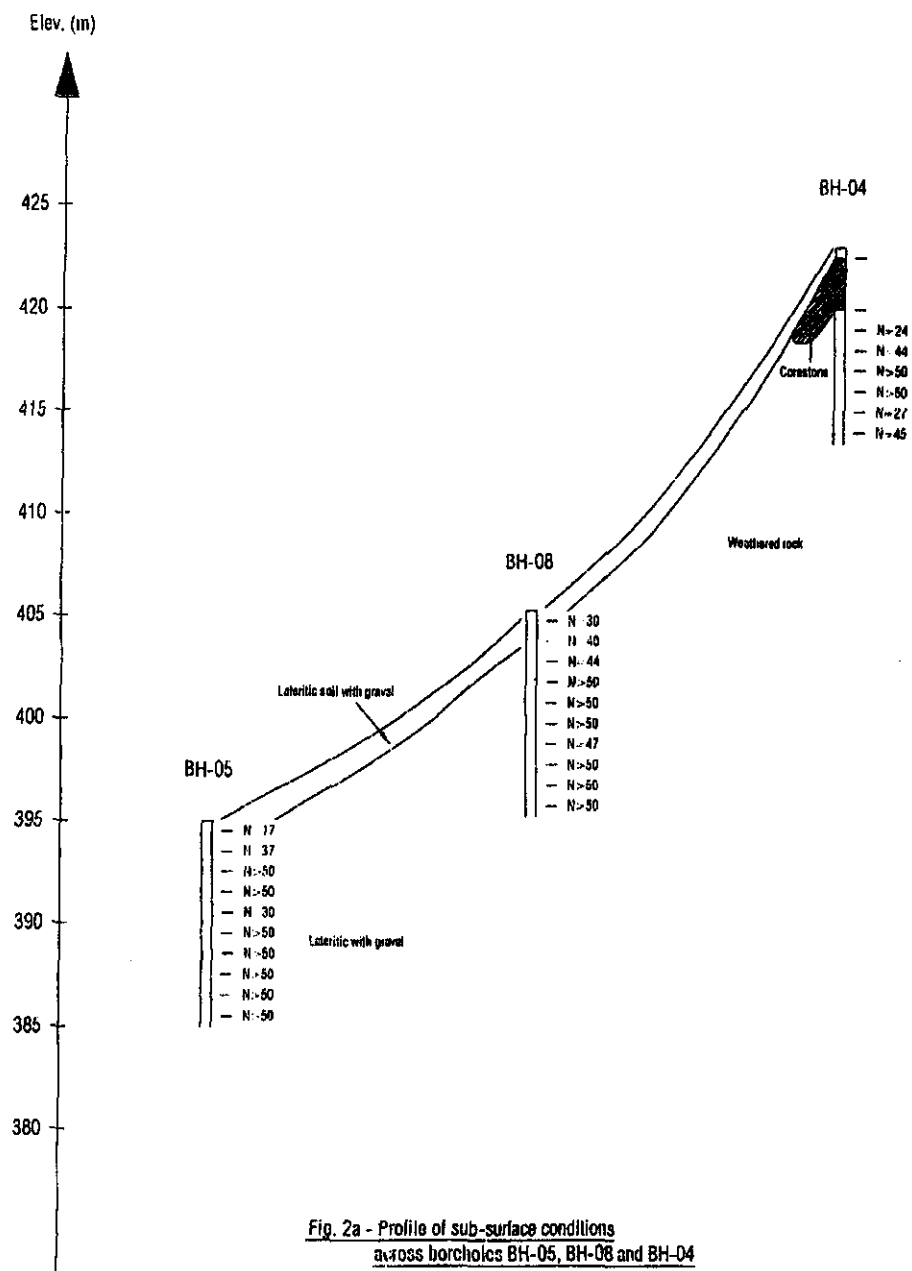
Borehole No. BH-09			
Depth = 3.5 m			
Depth to GWL = Not determined	k =	4.812E-04	cm/s
	k =	4.812E-06	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 2830.0	cm ³ /min	11821.7	ml/min.per sq.m
F = 192.2058 cm			
H _o = Not determined			

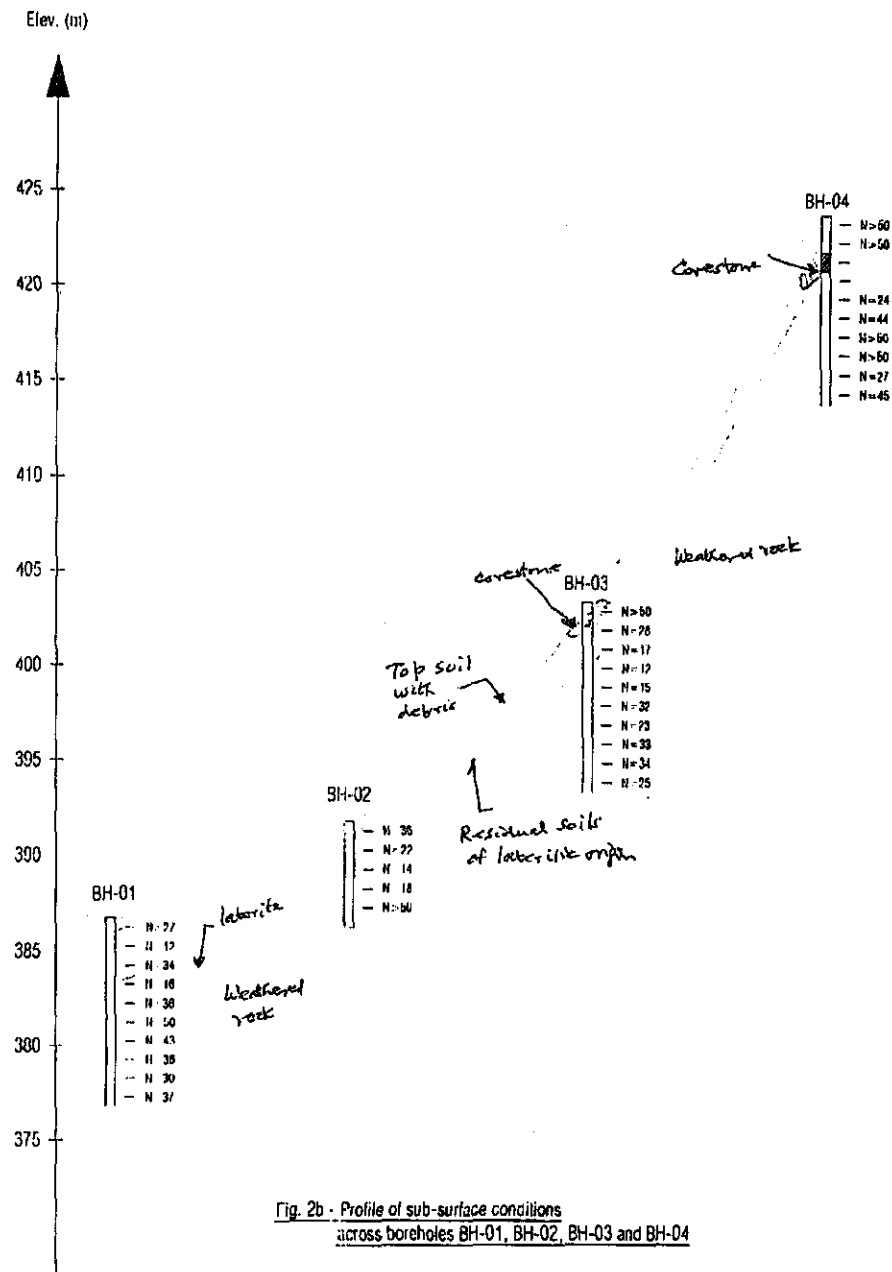
Borehole No. BH-10			
Depth = 9.0 m			
Depth to GWL = Not determined	k =	3.009E-05	cm/s
	k =	3.009E-07	m/s
k = q / (FH _o)		Rate of water absorption =	
q = (Q/t) = 177.0	cm ³ /min	739.4	ml/min.per sq.m
F = 192.2058 cm			
H _o = Not determined			

Fig.1-
SKETCH SHOWING BORE HOLE LOCATIONS
SOLID WASTE IMPROVEMENT PROJECT
SUDHGANGA WATTE, OWALA, MATALE



Scale $\rightarrow 1:200$





APPENDIX 1: Borehole Logs

BOREHOLE LOG					Job No: G/1511		Sheet : 1 of 1		
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 01		Level : MSL		
Consultant :-					Duration : 18/06/2003 to 19/06/2003				
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B				
					Logged by : D.K.P. Wijesekara.				
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		NX	0.50 - 0.95 SPT	27	Brownish Very fine sandy clay with debris			01	
02			1.50 - 1.95 SPT	12	Brownish to Blackish Lateritic soil with gravel			02	
03			2.50 - 2.95 SPT	34				03	
04			3.50 - 3.95 SPT	16	Brownish Black to White Laterite			04	
05			4.50 - 4.95 SPT	36				05	
06			5.50 - 5.95 SPT	>50	Reddish Brown to Whitish Laterite with gravel			06	
07			6.50 - 6.45 SPT	43	Brownish White to Black Very highly weathered rock			07	
08			GWL 7.30m 7.50 - 7.95 SPT	36	Brownish to White Very highly weathered rock			08	
09			8.50 - 8.95 SPT	30	Brownish Black to Whitish Very highly weathered rock			09	
10		NX	9.55 - 10.00 SPT	37	Brownish Yellow to White Very highly weathered rock			10	
Comments:		Weather Condition: Fair		Rock level: - BH terminated: 10.00m		GWL: 7.30m		Permeability Tests Conducted at 3.00m and 10.00m	
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881									

BOREHOLE LOG					Job No: G/1511	Sheet: 1 of 1
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 02	Level: MSL
Consultant :-					Duration : 19/08/2003 to 20/08/2003	
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B	
					Logged by : D.K.P. Wijesekara.	
Depth (m)	Water (m)	Case	In situ Tests and Samples	SPT No	Lithological Description	Penetration Resistance (Based on SPT values) 10 20 30 40
01		NX	0.50 - 0.95 SPT	36	Dark Brown Sandy clay with boulders and debris	
02			1.50 - 1.95 SPT	22	Dark Brown Very fine sandy clay	
03			2.50 - 2.95 SPT	14	Brownish Very fine sandy clay	
04			3.50 - 3.95 SPT	18	Brownish Very fine to fine sandy clay	
05			4.50 - 4.75 SPT	>50	Yellowish Brown to White Very highly weathered rock with mica	
06		NX			Yellowish Brown Very highly weathered rock	
07					Rock level Blackish Brown Rock	
08					BH terminated	
09						
10						
Comments: Weather Condition: Fair					Rock level: 4.70m BH terminated: 5.50m	GWL: Nil Conducted Permeability Tests at 5.50m
GEOTECH LIMITED, 13/1, Pepillyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881						

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1	
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 03	Level : MSL	
Consultant :-					Duration : 24/06/2003 to 24/06/2003		
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B		
					Logged by : D.K.P. Wijesekara.		
Depth (m)	Water (m)	Casing (mm)	In situ Tests and Samples	SPT No	Lithological Description	Penetration Resistance (Based on SPT values) 10 20 30 40	Depth (m)
01		NX	0.50 - 0.95 SPT	>50	Brownish Very fine to medium clayey sand with gravel		0.70
				Boulder			01
02			1.50 - 1.95 SPT	28	Brownish Very fine to medium clayey sand with gravel		02
			2.50 - 2.95 SPT	17			03
04			3.50 - 3.95 SPT	12	Yellowish Brown Very highly weathered rock		04
			4.50 - 4.95 SPT	15			05
06			5.50 - 5.95 SPT	32	Reddish Yellow to Brown Very highly weathered rock		06
			6.50 - 6.95 SPT	23			07
08			7.50 - 7.95 SPT	33			08
			8.50 - 8.95 SPT	34			09
10		NX	9.55 - 10.00 SPT	25			10
Comments:		Weather Condition: Fair	Rock level: - BH terminated: 10.00m		GWL: Nil	Permeability Tests Conducted at 3.00m and 10.00m	
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881							

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1												
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 04	Level : MSL												
Consultant :-					Duration : 26/06/2003 to 26/06/2003													
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B													
					Logged by : D.K.P. Wijesekara.													
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Penetration Resistance (Based on SPT values) 10 20 30 40	Depth (m)											
01		NX	0.50 - 0.95 SPT	>50	Brownish Very fine to medium clayey sand with gravel		01											
02			1.50 - 1.95 SPT	>50	Yellowish Brown Boulder		02											
03					<table><tr><th>Depth (m)</th><th>C/R %</th><th>RQD %</th></tr><tr><td>2.00 - 2.50</td><td>38</td><td>NII</td></tr><tr><td>2.50 - 3.00</td><td>90</td><td>NII</td></tr></table>	Depth (m)	C/R %	RQD %	2.00 - 2.50	38	NII	2.50 - 3.00	90	NII				03
Depth (m)	C/R %	RQD %																
2.00 - 2.50	38	NII																
2.50 - 3.00	90	NII																
04							04											
05			4.50 - 4.95 SPT	24	Pinkish Brown Very highly weathered rock with mica		05											
06			5.50 - 5.95 SPT	44	Pinkish Brown to Grey Very highly weathered rock		06											
07			6.50 - 6.95 SPT	>50	Brownish Very highly weathered rock		07											
08			7.50 - 7.95 SPT	>50			08											
09			8.50 - 8.95 SPT	27	Brownish Very highly weathered rock with mica		09											
10		NX	9.00 - 9.45 SPT	45	Yellowish Brown to Grey Very highly weathered rock		10											
Comments:		Weather Condition: Hot		Rock level: BH terminated: 10.00m		GWL: Nil		Permeability Tests Conducted at 3.00m and 10.00m										
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881																		

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1		
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 05	Level : MSL		
Consultant :-					Duration : 20/06/2003 to 21/06/2003			
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B			
					Logged by : D.K.P. Wijesekara.			
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		NX	0.50 - 0.95 SPT	17	Reddish Brown Lateritic soil with gravel			01
02			1.50 - 1.95 SPT	37	Reddish Brown Laterite with gravel			02
03			2.50 - 2.95 SPT	>50	Reddish Brown to Yellow Laterite			03
04			3.50 - 3.95 SPT	>50	Reddish Brown Laterite with gravel			04
05			4.50 - 4.95 SPT	30				05
06			5.50 - 5.95 SPT	>50				06
07			6.50 - 6.95 SPT	>50				07
08			7.50 - 7.95 SPT	>50	Reddish Brown to Yellow Laterite			08
09			8.50 - 8.95 SPT	>50				09
10		NX	9.00 - 9.45 SPT	>50				10
Comments:		Weather Condition: Fair	Rock level: BH terminated: 10.00m	GWL: Nil	Permeability Tests Conducted at 3.00m and 10.00m			
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881								

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1	
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 06	Level : MSL	
Consultant :-					Duration : 22/06/2003 to 22/06/2003		
Project : Geological Survey for improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B		
					Logged by : D.K.P. Wijesekara.		
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Penetration Resistance (Based on SPT values) 10 20 30 40	Depth (m)
01		NX	0.50 - 0.95 SPT	4	Dark Brown Very fine to fine clayey sand with gravel		01
02					Brownish Very fine to medium clayey sand		02
03			2.50 - 2.95 SPT	19	Boulder Brownish Very fine to medium clayey sand		03
04			3.50 - 3.95 SPT	12	Boulder		04
05			4.50 - 4.95 SPT	20	Brownish Very highly weathered rock with mica		05
06			5.50 - 5.95 SPT	46	Yellowish Brown Very highly weathered rock		06
07			6.50 - 6.95 SPT	33	Whitish Brown Very highly weathered rock		07
08			7.50 - 7.95 SPT	36	Yellowish Green Very highly weathered rock with mica		08
09			8.50 - 8.95 SPT	>50	Yellowish Brown to White Very highly weathered rock		09
10		NX	9.55 - 10.00 SPT	>50	Yellowish Green to White Very highly weathered rock		10
Comments:		Weather Condition: Fair	Rock level: -	BH terminated: 10.00M	GWL: Nil	Permeability test Conducted at 10.00m * - About 20% loss of water at 2.33 and 5.50	
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881							

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1		
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 07	Level : MSL.		
Consultant : -					Duration : 23/06/2003/ to 23/06/2003			
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B			
					Logged by : D.K.P. Wijesekara.			
Depth (m)	Water (m)	Case	In situ Tests and Samples	SPT No	Lithological Description	Legend	Penetration Resistance (Based on SPT values) 10 20 30 40	Depth (m)
01		NX	0.50 - 0.95 SPT	17	Dark Brown Very fine to medium clayey sand with gravel			01
02			1.50 - 1.95 SPT	>50	Brownish Very fine to medium clayey sand with gravel			02
03			2.50 - 2.95 SPT	>50				03
04			3.50 - 3.95 SPT	>50	Yellowish Brown Very highly weathered rock			04
05			4.50 - 4.95 SPT	>50				05
06			5.50 - 5.95 SPT	>50				06
		NX			Hard rock			6.50
07					BH terminated			07
08								08
09								09
10								10
Comments:		Weather Condition: Fair	Rock level: BH terminated: 6.50m	GWL: Nil	Permeability test Conducted at 3.0m and 6.50m			
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881								

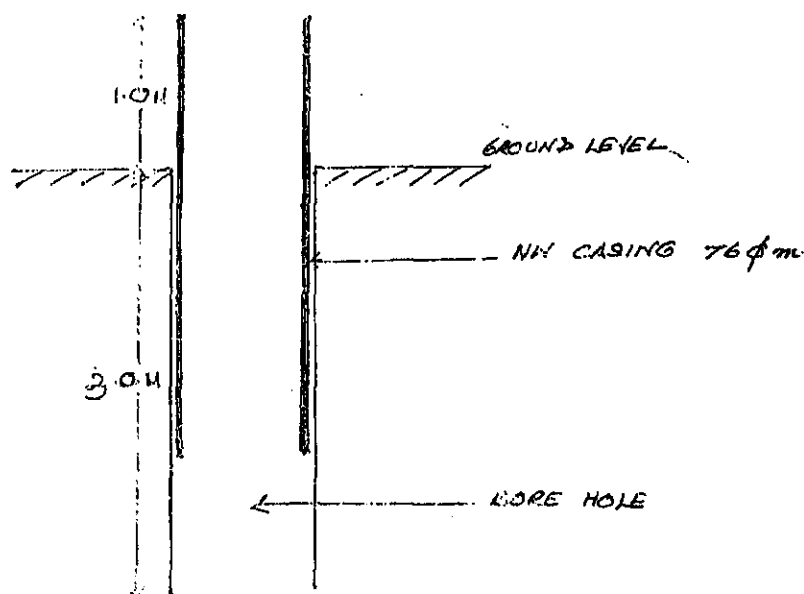
BOREHOLE LOG					Job No: G/1611	Sheet : 1 of 1		
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 08	Level : MSL		
Consultant :-					Duration : 25/08/2003/ to 25/08/2003			
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B			
					Logged by : D.K.P. Wijesekara.			
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) 10 20 30 40	D e p t h (m)
01		NX	0.50 - 0.95 SPT	30	Dark Brown Very fine to medium clayey sand gravel			01
02			1.50 - 1.95 SPT	40				02
03			2.50 - 2.95 SPT	44	Brownish to White Very highly weathered rock with mica.			03
04			3.50 - 3.95 SPT	>50				04
05			4.50 - 4.95 SPT	>50	Reddish Brown Very highly weathered rock			05
06			5.50 - 5.95 SPT	>50	Brownish Very highly weathered rock			06
07			6.50 - 6.95 SPT	47	Grayish to White Very highly weathered rock			07
08			7.50 - 7.95 SPT	>50				08
09			8.50 - 8.95 SPT	>50	Brownish to White Very highly weathered rock			09
10		NX	9.55 - 10.00 SPT	>50	Reddish Brown Very highly weathered rock			10
Comments:		Weather Condition: Fair	Rock level: -	BH terminated: 10.00m	GWL: Nil	Permeability test Conducted at 3.0m and 10.00m		
GEOTECH LIMITED, 13/1, Pepliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881								

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1												
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 09	Level : MSL												
Consultant :-					Duration : 24/06/2003/ to 24/06/2003													
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B													
					Logged by : D.K.P. Wijesekara.													
Depth (m)	Water (m)	Case (mm)	In situ Tests and Samples	SPT No	Lithological Description	Penetration Resistance (Based on SPT values) 10 20 30 40	Depth (m)											
01		NX	0.50 - 0.95 SPT	>50	Dark Brown Very fine to fine clayey sand with gravel		01											
					Light Grey Mica													
02			1.50 - 1.95 SPT	>50	Brownish Very fine to fine sandy clay		02											
					Yellowish Brown Very highly weathered rock													
03			2.50 - 2.95 SPT	>50	Rock level		03											
04					Yellowish Brown Rock		04											
05		NX			BH terminated		05											
06							06											
07							07											
08							08											
09							09											
10							10											
<table border="1"> <thead> <tr> <th>Depth (m)</th> <th>C/R %</th> <th>R.Q.D. %</th> </tr> </thead> <tbody> <tr> <td>2.00 - 2.50</td> <td>40</td> <td>Nil</td> </tr> <tr> <td>2.50 - 3.50</td> <td>40</td> <td>Nil</td> </tr> <tr> <td>3.50 - 4.50</td> <td>35</td> <td>Nil</td> </tr> </tbody> </table>					Depth (m)	C/R %	R.Q.D. %	2.00 - 2.50	40	Nil	2.50 - 3.50	40	Nil	3.50 - 4.50	35	Nil		
Depth (m)	C/R %	R.Q.D. %																
2.00 - 2.50	40	Nil																
2.50 - 3.50	40	Nil																
3.50 - 4.50	35	Nil																
Comments: Weather Condition: Fair Rock level: 2.00m BH terminated: 4.50m GWL: Nil Permeability test Conducted at 4.50m																		
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881																		

BOREHOLE LOG					Job No: G/1511	Sheet : 1 of 1		
Client : Kokusai Kogyo Co. Ltd.					B.H. No: 10	Level : MSL		
Consultant :-					Duration : 27/08/2003/ to 27/08/2003			
Project : Geological Survey for Improvement of Solid Waste Management at Owala, Matale.					Drilling Rig: XYL-1B			
					Logged by : D.K.P. Wijesekara.			
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) 10 20 30 40	D e p t h (m)
01		NX	0.50 - 0.95 SPT	18	Brownish Very fine to medium clayey sand			01
02			1.50 - 1.95 SPT	20	Brownish Very fine to fine clayey sand			02
03			2.50 - 2.95 SPT	9	Brownish Very fine sandy clay			03
04			3.50 - 3.95 SPT	24	Dark Brown Very fine to fine clayey sand			04
05			4.50 - 4.95 SPT	30				05
06			5.50 - 5.95 SPT	26	Yellowish Brown Very fine to medium clayey sand			06
07			6.50 - 6.95 SPT	>50				07
08			7.50 - 7.95 SPT	>50	Yellowish Brown Very highly weathered rock			08
09			8.50 - 8.95 SPT	>50				09
10		NX	9.55 - 10.00 SPT	>50	Yellowish to White Very highly weathered rock			10
Comments:		Weather Condition: Hot		Rock level: - BH terminated: 10.00m	GWL: Nil	Permeability test Conducted at 10.00m		
GEOTECH LIMITED, 13/1, Pepiliyana Mawatha, Kohuwala, Nugegoda. Tel/Fax: 823881								

APPENDIX 2: Permeability Test Results

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE -
CONSTANT HEAD PERMEABILITY TEST AT BH-01



DEPTH - 30M.

TIME	DURATION MTS	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
3.20				
3.30	10	0.40M	1950	1950
3.40	10	0.25M	1200	3150
3.50	10	0.24M	1200	4350
4.00	10	0.31M	1540	5890
4.10	10	0.19M	1000	6890
4.20	10	0.19M	980	7870

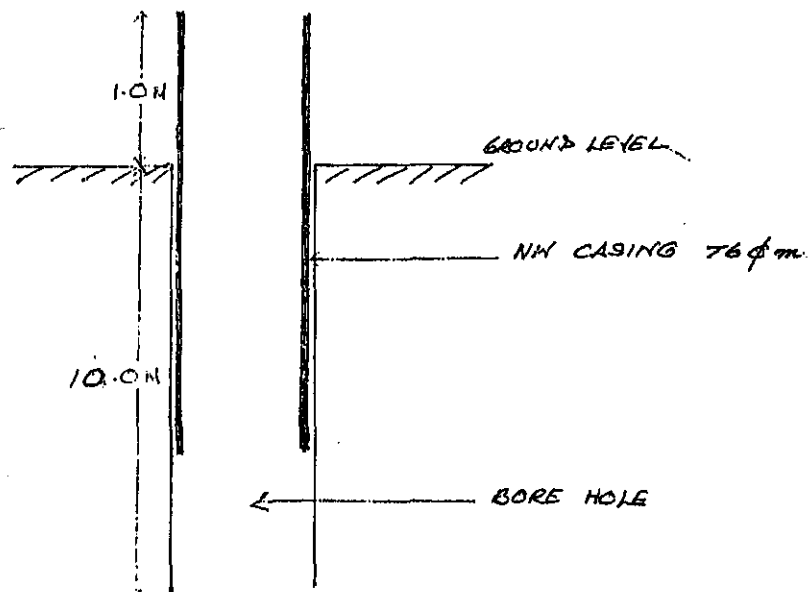
DATE: 18-06-03

BWL = 7.30 m

$$AQ = \frac{2890 - 4350}{2.0} = 127.0 \text{ ml/min.}$$

(1)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE -
CONSTANT HEAD PERMEABILITY TEST AT BH-01



G.W.L - 7.30M DEPTH - 10M

TIME	DURATION MINS.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
12.15				
12.25	10	0.69 M	3700	3700
12.35	10	0.81 M	4000	7700
12.45	10	0.79 M	4000	11,700
12.55	10	0.36 M	1800	13,500
1.05	10	0.71 M	3800	17,300
1.15	10	0.68 M	3300	20,600

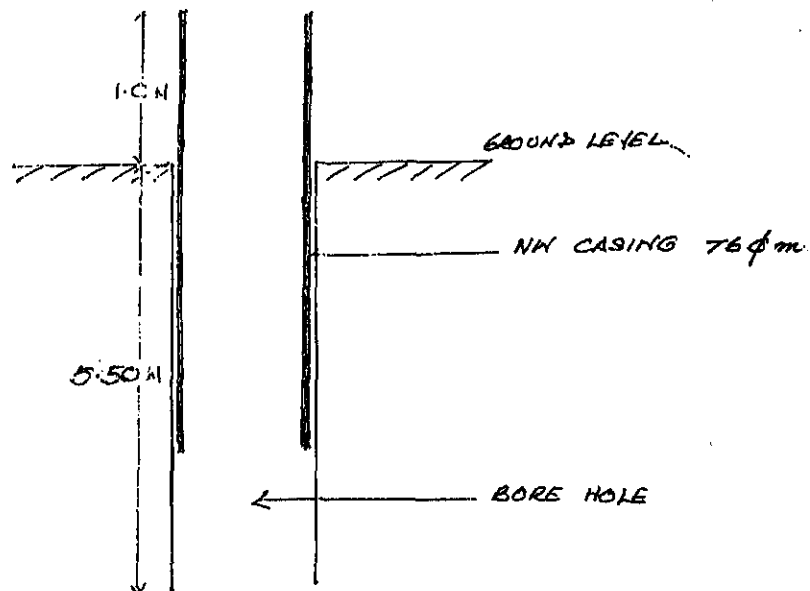
DATE: 19-06-03

G.W.L. = 7.30 m

$$\frac{\Delta Q}{\Delta t} = \frac{20,600 - 7700}{40} = 322.5 \text{ ml/min}$$

(2)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE.
CONSTANT HEAD PERMEABILITY TEST AT BH-02



G.W.L. NIL

DEPTH - 5.50M

TIME	DURATION MINS.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.
9.15			
9.25	10	1.02M	3500
9.35	10	0.68M	2925
9.45	10	0.59M	2575
9.55	10	0.60M	2950
10.05	10	0.81M	4250
10.15	10	0.91M	4325

3500"

6425"

9200"

11,950"

16,200"

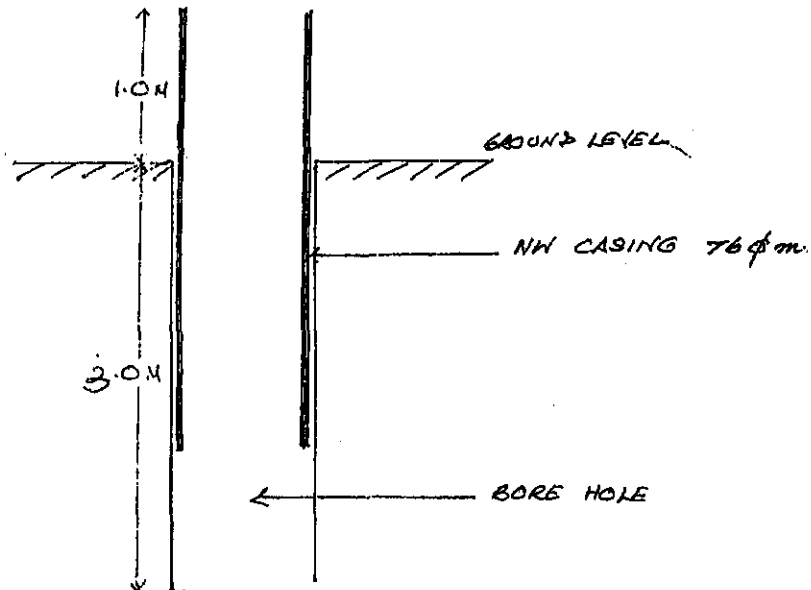
20,525"

DATE: 20-06-03

BWL = -

$$\frac{\Delta Q}{\Delta t} = \frac{16,200 - 6425}{3.0} = 3250.8 \text{ ml/min}$$

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE,
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-03



DEPTH - 3.0M

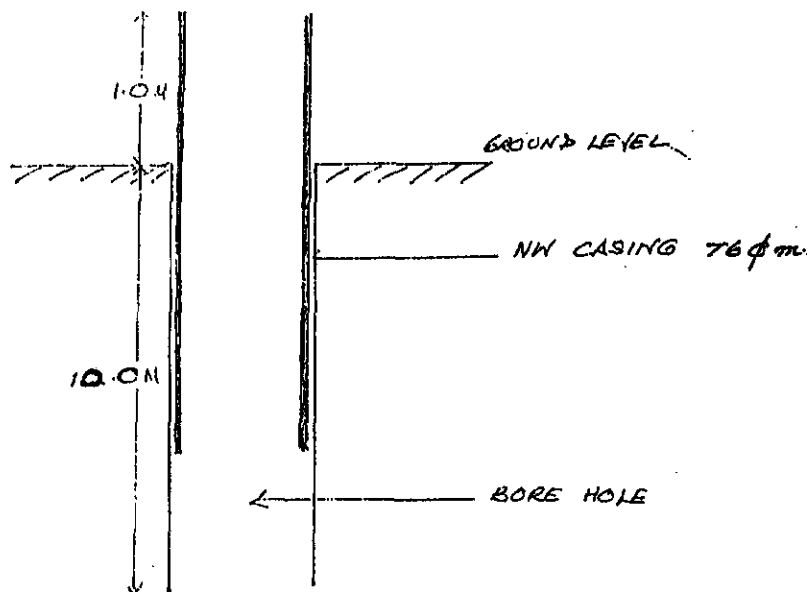
TIME	DURATION MINS.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
3.02				
3.12	10	1.22M	6040	6040
3.22	10	1.22M	5480	11,520
3.32	10	1.29M	6260	17,780
3.42	10	1.31M	6140	23,920
3.52	10	1.29M	6700	30,620
4.02	10	1.29	6600	37,220

DATE: 24-06-03

- GWL = -

$$\frac{AQ}{AL} = \frac{37,220 - 11,520}{40} = 642.5 \text{ ml/min}$$

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE,
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE.
CONSTANT HEAD PERMEABILITY TEST AT BH-BH-03



G.W.L - NIL

DEPTH - 10.4.

TIME	DURATION MTS	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
8.05 8.18	10	9.704	240,000	240,000
8.28	10	8.554	240,000	480,000
8.38	10	8.524	240,000	720,000
8.48	10	8.514	238,000	958,000
8.58	10	8.504	238,000	1,196,000
9.08	10	8.494	237,000	1,433,000

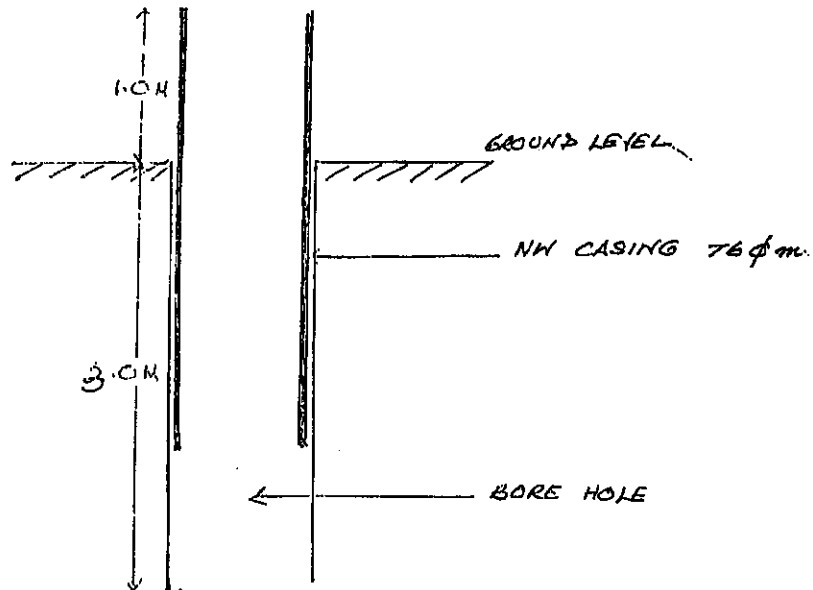
DATE: 25-06-03

G.W.L. = -

$$AQ = \frac{1,433,000}{80} = 23,880 \text{ m.l./min}$$

(5)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE,
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE.
CONSTANT HEAD PERMEABILITY TEST AT BH-04



DEPTH - 30 M

TIME	DURATION MINS.	DRAIN DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
10.42				
10.52	10	1.12 M	4780	4780
11.02	10	0.92 M	4000	8780
11.12	10	0.95 M	4700	13,480
11.22	10	0.93 M	4200	17,680
11.32	10	0.92 M	4200	21,880
11.42	10	0.98 M	4300	26,180

DATE: 26-06-03

$G_{KH} = -$

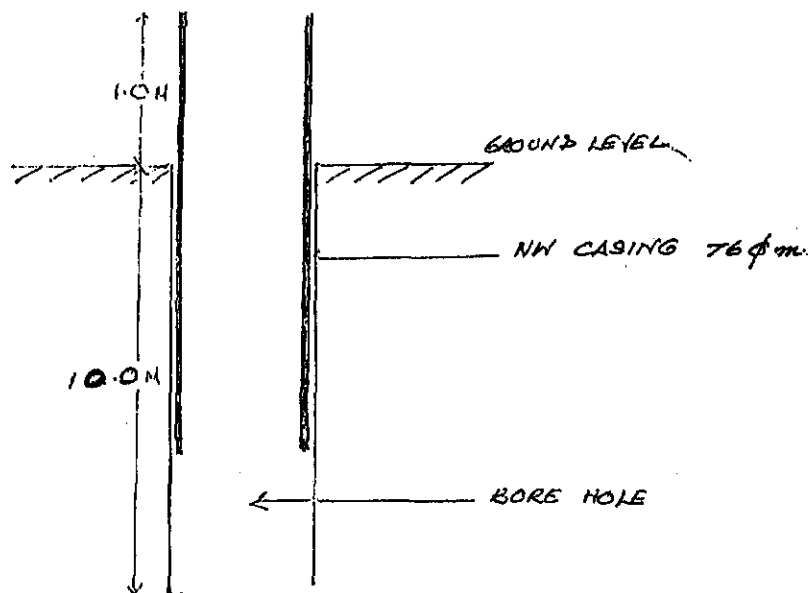
ΔQ
 $\Delta t =$

$$26,180 - 8780 = 435.0 \text{ m}^3/\text{mh}$$

$$40$$

(6)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE,
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE.
CONSTANT HEAD PERMEABILITY TEST AT BH-04



G.W.L. - NL DEPTH - 10.0M

TIME	DURATION MTS.	DRAIN DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
4.41 4.51	10	1.53M	7480	7480
5.01	10	1.48M	6220	13,700
5.11	10	1.22M	6100	19,800
5.21	10	1.15M	5200	25,000
5.31	10	1.10M	5100	30,100
5.41	10	1.08M	5000	35,100

DATE: 26-06-03

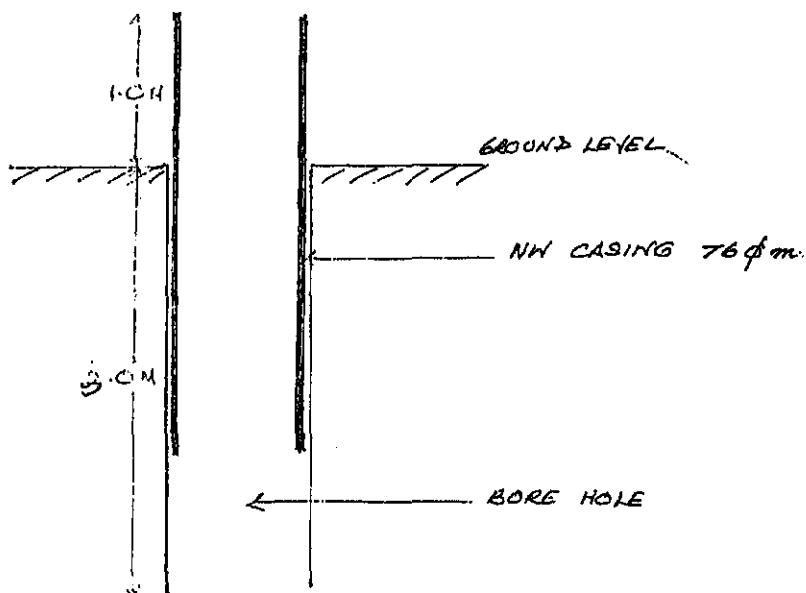
G.W.L. -

$$AQ = \frac{35,100 - 19,800}{30} = 510.0 \text{ ml/min}$$

AE

(7)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-05



G.W.L - NIL

DEPTH - 3.0 M

TIME	DURATION MINS	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
3.12				4280
3.22	10	0.91 M	4280	
3.32	10	0.80 M	2900	7180
3.42	10	0.63 M	3180	10,360
3.52	10	0.60 M	3220	13,580
4.02	10	0.62 M	3400	16,980
4.12	10	0.74 M	3820	20,800

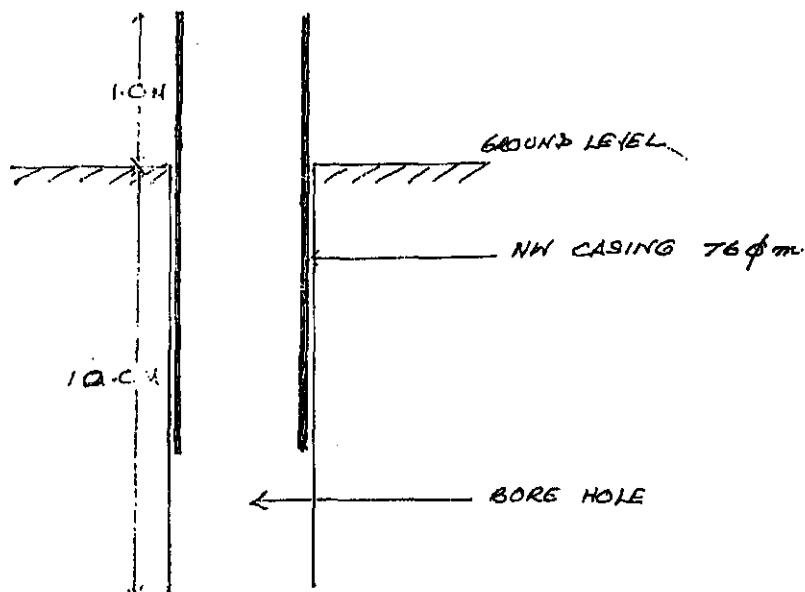
DATE: 20-06-03

G.W.L = -

$$AR = \frac{16,980 - 7,180}{30} = 326.7 \text{ ml/min}$$

At

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-05



G.W.L. - NIL

DEPTH - 10M

TIME	DURATION MINS.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
12.05				720
12.15	10	0.14	720	1520
12.25	10	0.16	800	2220
12.35	10	0.14	700	3020
12.45	10	0.16	800	3540
12.55	10	0.09	520	4160
1.05	10	0.13	620	

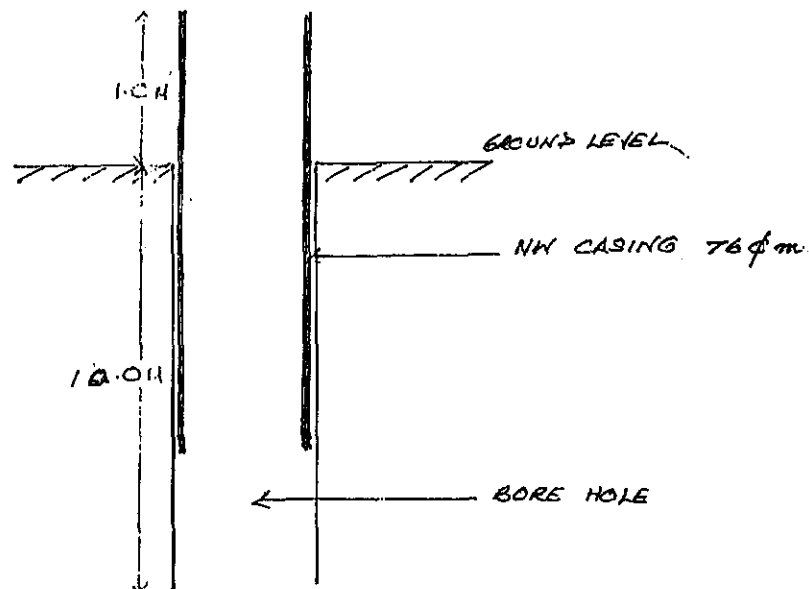
DATE: 21-06-03

GWL = -

$$\frac{\Delta Q}{\Delta t} = \frac{4160 - 1520}{40} = 65.0 \text{ ml/min.}$$

9

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTIE, ONALA, MATALE -
CONSTANT HEAD PERMEABILITY TEST AT BH-BH-06



G.W.L - NIL

DEPTH - 10.0M

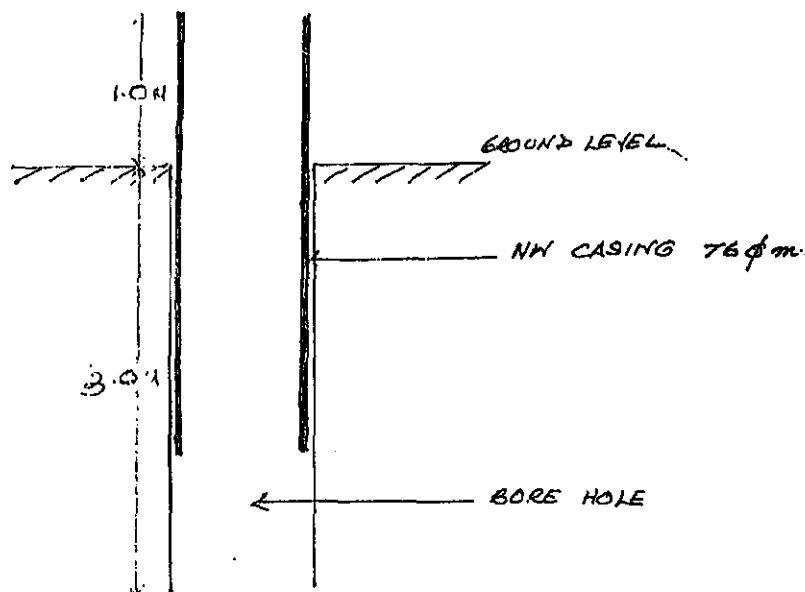
TIME	DURATION MIS	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
3.25				
3.35	10	2.10M	56,000	56,000
3.45	10	1.85M	56,000	112,000
3.55	10	1.95M	62,000	174,000
4.05	10	1.90M	62,000	236,000
4.15	10	2.00M	63,000	299,000
4.25	10	2.10M	63,500	362,500

DATE: 22-06-03

G.W.L. -

$$\frac{AQ}{At} = \frac{362,500 - 112,000}{40} = 6262.5 \text{ ml/min}$$

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-07



DEPTH - 3.0 M

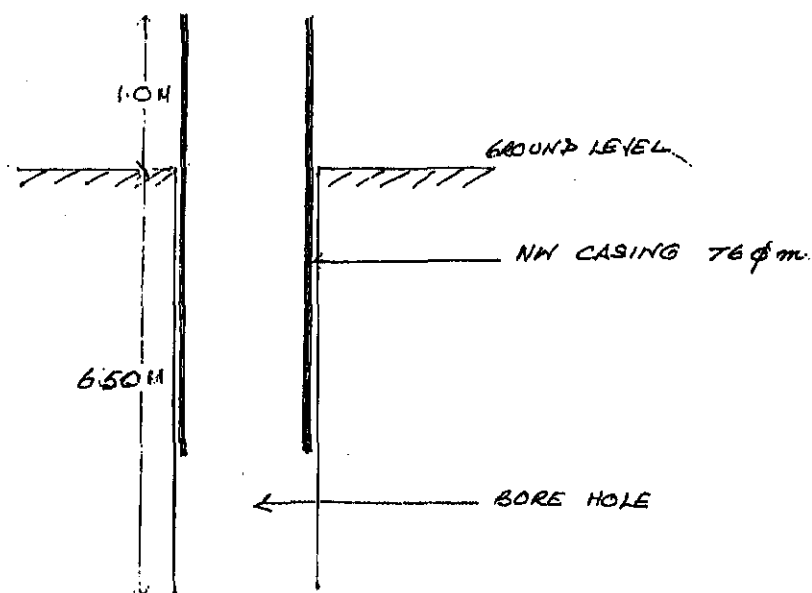
TIME	DURATION MINS.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
9.05				
9.15	10	1.52 M	14,000	14,000
9.25	10	1.55 M	12,800	26,800
9.35	10	1.60 M	13,900	40,700
9.45	10	1.47 M	11,800	52,500
9.55	10	1.61 M	15,000	67,500
10.05	10	1.60 M	14,100	81,600

DATE: 23-06-03

GWL :-

$$AQ = \frac{81,600 - 14,000}{50} = 1352.0 \text{ ml/min}$$

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUBUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-07



G.W.L. NIL DEPTH - 6.50M

TIME	DURATION MTC.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
2.20				2000
2.30	10	0.49M	2000	
2.40	10	0.23M	1400	3400
2.50	10	0.29M	1500	4900
3.00	10	0.26M	1300	6200
3.10	10	0.28M	1470	7670
3.20	10	0.27M	1350	9020

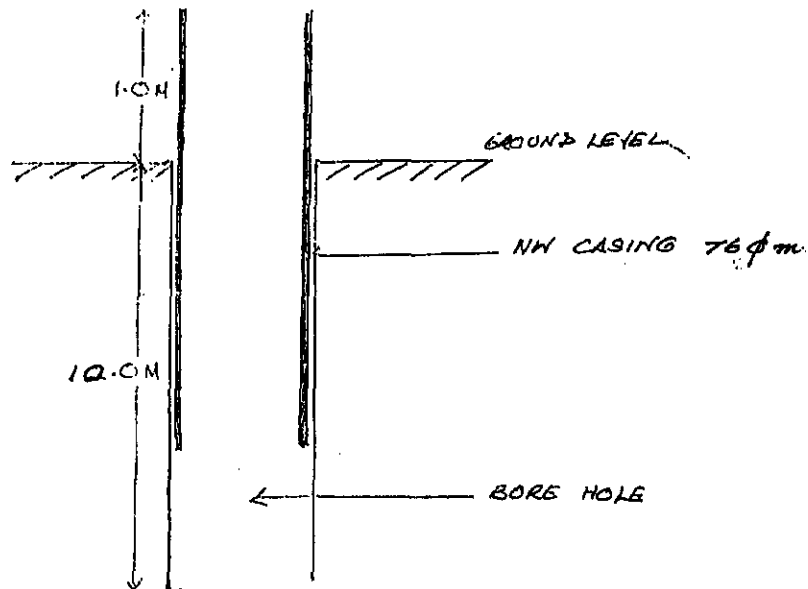
DATE: 23-06-03

BWL. -

$$\frac{\Delta Q}{\Delta t} = \frac{9020 - 3400}{40} = 140.5 \text{ ml/min.}$$

(15)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE,
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-08



G.W.L. - NIL

DEPTH - 10.0M

TIME	DURATION MINS.	DRAIN DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
3.45				2000
3.55	10.0	0.47M	2000	4000
4.05	10.0	0.60M	2000	5600
4.10	10.0	0.31M	1600	8000
4.20	10.0	0.49M	2400	10,000
4.30	10.0	0.40M	2000	12,000
4.35	10.0	0.40M	2000	

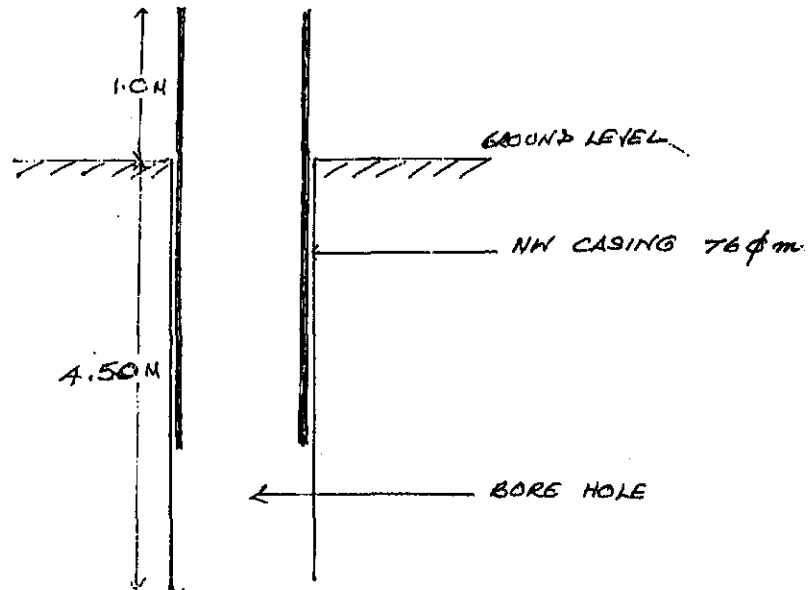
DATE: 25-06-03

G.W.L. = -

$$\frac{A_2}{A_1} = 200 \text{ ml/min}$$

(13)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE -
CONSTANT HEAD PERMEABILITY TEST AT BH-09



G.W.L. - NIL

DEPTH - 4.50M

TIME	DURATION MINS.	DRAW DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
11.02				
11.12	10	3.15 M	28,700	28,700
11.22	10	3.22 M	29,080	57,700
11.32	10	3.27 M	30,080	87,700
11.42	10	2.85 M	27,400	115,100
11.52	10	3.25 M	28,000	143,100
12.02	10	3.20 M	27,800	170,900

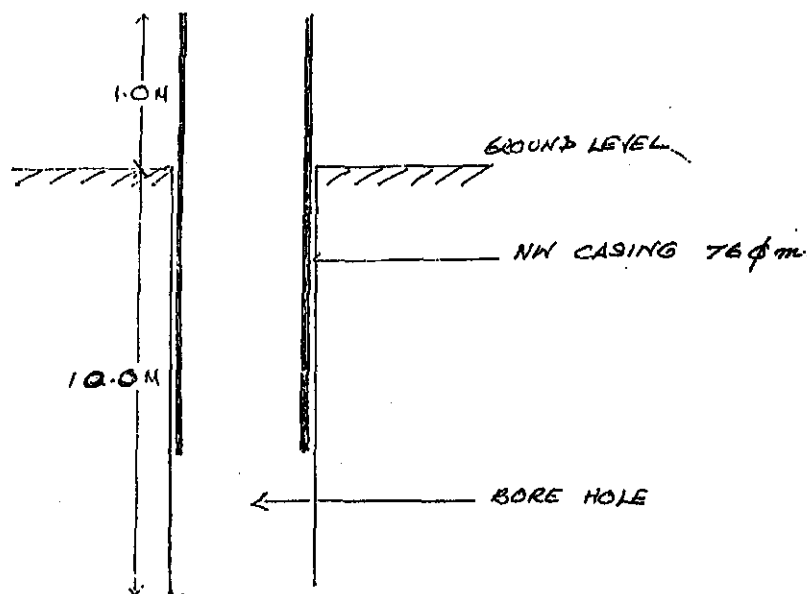
DATE: 24-06-03

QWL = -

$$\frac{AQ}{At} = \frac{170,900 - 57,700}{40} = 2830.0$$

(14)

GEOLOGICAL SURVEY FOR IMPROVEMENT OF SOLID WASTE,
MANAGEMENT AT SUDUGANGAWATTE, ONALA, MATALE
CONSTANT HEAD PERMEABILITY TEST AT BH-10



DEPTH - 10.0 M

TIME	DURATION MINS	DRAIN DOWN FROM TOP OF THE CASING	WATER TAKEN M/LTS.	
3.38 3.48	10	1.35 M	6800	6800
3.58	10	0.98 M	4800	11,600
4.08	10	0.91 M	3460	15,060
4.18	10	0.72 M	2800	17,860
4.28	10	0.53 M	2000	19,860
4.38	10	0.32 M	1540	21,400

DATE: 27-06-03

GWL = -

$$\frac{\Delta Q}{\Delta t} = \frac{21,400 - 17,860}{20} = 177.0 \text{ ml/mh.}$$

(15)

APPENDIX 3: Summary of Analysis of Permeability Test Results

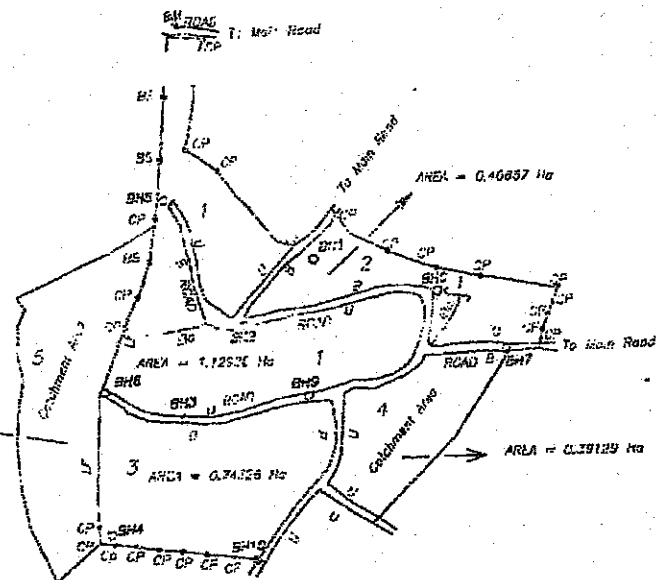
BH1	105.20	
BH2	189.28	
BH3	107.14	
BH4	125.91	
BH5	104.57	392.22
BH6	100.21	212.21
BH7	102.11	112.35
BH8	104.04	112.02
BH9	101.20	411.28
BH10	103.42	412.42

Extent					
Lot No.	Ha.	A.	P.	P.	
1	1.12738	2	3	05.47	
2	0.40467	1	2	00.78	
3	0.77424	1	1	17.88	
Total	2.32629	5	2	24.13	

Area of Roads 0.28188 Ha

AREA = 2.67869 Ha

Extent of Catchment Area
 LOT 5 AREA = 0.87028 Ha
 LOT 4 AREA = 0.38129 Ha
 TOTAL AREA = 1.05157 Ha



BH1	184.23
BH2	141.28
BH3	117.16
BH4	274.91
BH5	184.67
BH6	122.51
BH7	122.31
BH8	124.25
BH9	111.28
BH10	111.28

Extent					
Lot No.	No.	A	H	P	
1	1.1225	2	3	05.47	
2	0.4450	1	0	00.78	
3	0.7414	1	1	11.78	
Total	2.2729	4	4	18.03	

Area Of Roads 0.3755 Ha

Area = 0.67084 Ha

Extent Of Catchment Area
 LOT 5 AREA = 0.5705 Ha
 LOT 4 AREA = 0.38129 Ha
 TOTAL AREA = 1.05179 Ha

