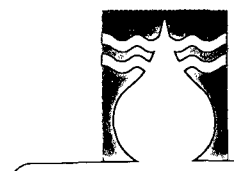
An Evaluation of the Enviro Loo Composting Latrine in an Informal Settlement Area in Greater Johannesburg

Report to the Water Research Commission
and
the Greater Johannesburg Metropolitan Council
by
Stewart Scott

WRC Report No KV 112/98



A REPORT TO THE GREATER JOHANNESBURG METROPOLITAN COUNCIL AND THE WATER RESEARCH COMMISSION

AN EVALUATION OF THE ENVIRO LOO COMPOSTING LATRINE IN AN INFORMAL SETTLEMENT AREA IN GREATER JOHANNESBURG

by

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EXECUTIVE SUMMARY

Many people in South Africa do not have access to adequate sanitation facilities. As a result of economic and financial constraints, water scarcity and a backlog of inadequate provision of water and sanitation to growing informal communities, sanitation systems other than waterborne have received increasing attention.

The composting latrine system is one of these alternative sanitation systems. Implicit to composting latrine technology is the notion of a dry (waterless) on-site system that accepts human excreta which gradually breaks down to produce a compost-like material that is safe for handling and disposal.

In December 1995, the Water Research Commission provided support to a research proposal submitted by the Greater Johannesburg Metropolitan Council for the investigation of a locally developed dry sanitation system known as the "Enviro Loo". The research project, which evaluated and monitored the performance of 30 Enviro Loo latrines over a period of 12 months in an informal settlement (Elias Motsoaledi) near Johannesburg, made the following main findings:

- the Enviro Loo latrines performed adequately, under conditions of full and free institutional and maintenance support, and were generally accepted by users as a satisfactory alternative to communal chemical toilets;

- at the end of the trial period, the Enviro Loo latrine users mentioned safety, privacy and accessibility as preferred aspects of the sanitation system, whilst the most unfavourable aspect of the system mentioned was that the toilets do not flush;

- the robustness and physical integrity of the latrines was generally good, but a design fault in the Enviro Loo sanitation system identified during the trial was the failure of the agitator rod mechanism in one third of the latrines (the design has been subsequently modified by the developer);

- no adverse health impacts amongst the Enviro Loo latrine users, which could be associated with the use of the latrines, were identified during the trial although it must be noted that no baseline health data on the general health of the Elias Motsoaledi community were collected prior to the study;

- no sludge removal was required from the Enviro Loo containers during the study period, but the pumping out of stormwater and grey water was necessary in some instances, although this was not the fault of the system itself;

- issues of user education, maintenance and institutional support, as well as the disposal of grey water are critical to the successful implementation of this technology;

- although the Enviro Loo latrines performed satisfactorily as toilets, it is evident that after 12 months, the technology can not operate as a complete waste treatment system;

- very little evidence of composting activity in the latrine containers was observed during the study period - the moisture, temperature and aeration conditions may not have been ideal, thereby inhibiting biological activity or slowing down the composting process and preventing the complete destruction of pathogens in the waste pile;

- the slow rate of breakdown of the waste piles in the Enviro Loo containers indicates that the faecal waste can not be safely utilised as an organic fertiliser or soil conditioner without further treatment; and

- the Enviro Loo technology acts more as a prolonged process of dehydration rather than a composting latrine (this is recognised by the developer who advocates the further treatment of the waste material once removed from the latrine container).

Additional trials and research over a longer period of time are therefore recommended to further assess the performance of the latrines and the composting process. Such investigations are required to determine user acceptance of the latrines (based on payment of actual capital and maintenance costs) and to ascertain the health impacts of the latrines when compared to alternative sanitation systems under the same conditions.

Trials should also be carried out in different types of settlements (rural, peri-urban and urban township) in order to assess the social impact under varying conditions of support, including where support from local government and the manufacturers is limited (eg with current household subsidies and where operation and maintenance costs are covered by the households themselves). The trials could include the more than 3 000 Enviro Loo latrines already installed in different areas of South Africa under a wide variety of different conditions.

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1. INTRODUCTION

In much of South Africa, in both urban and rural areas, significant proportions of the population do not have access to adequate sanitation (and water supply) facilities. This impacts negatively on the quality of life, health and productivity of people, as well as the local environment.

Although there are a variety of sanitation technologies available which have been applied or tested in the region, it is a common perception in South Africa, particularly in urban areas, that waterborne sanitation is ultimately the only satisfactory and acceptable method of dealing with human excreta. However, due to economic and financial constraints, water scarcity and a backlog of inadequate provision of water and sanitation to growing informal communities, sanitation systems other than waterborne have received increasing attention in many developing countries. This situation also applies to South Africa (Stewart Scott, 1995).

Within the South African context, a number of alternative sanitation systems to waterborne sanitation have emerged which, in theory, substantially fulfill accepted health and system norms (ie a system which receives human excreta, urine and anal cleansing material for treatment and disposal in a manner which is both acceptable to users and poses no health threat). Of these alternative sanitation systems, the ventilated improved pit (VIP) latrine system and the composting latrine system have attracted considerable attention.

The use of the VIP system has gained popularity in South Africa (as an improvement on the basic pit latrine) and has been approved by the Department of Water Affairs and Forestry as a minimum basic level of sanitation service. The composting latrine, however, has only seen very recent (1993) use in this country and is still relatively unknown in the region. Implicit to composting latrine technology is the notion of a dry on-site sanitation system and of accepting human excreta as a source of nutrient rich organic material which can be composted to produce a material which is safe for handling and disposal. Thus conditions are created in the latrine which promote aeration of the organic mass to aid its decomposition, elevated temperatures to kill pathogens, as well as the prevention or minimisation of free water in the latrine container via the separation of solid and liquid material and a ventilation system which accelerates evaporation of the liquid waste. Access to the latrine container via a manhole facilitates removal of the processed human waste for use as a soil conditioner or compost.

In December 1995, the Water Research Commission (WRC) provided support to a research proposal submitted by the Greater Johannesburg Metropolitan Council (GJMC) for the investigation of a dry (waterless) sanitation system. The proposal involved evaluating the performance of the locally developed and manufactured "Enviro Loo" composting latrine in an informal settlement in the Johannesburg area. Although a number of these latrines have recently been installed and used in several locations around South Africa, the project represented the first local, large scale independent trial and assessment of the technology. A diagram depicting the Enviro Loo latrine is shown in Figure 1.

The basic Enviro Loo unit consists of a plastic container measuring 1 800mm long x 600mm wide x 1 300 mm deep, which is placed in an excavated hole in the ground. Inside the container are a main grid onto which faecal material falls, below which are a number of inter-linked plastic grids sloping to the back of the container, and a collection box at the bottom of the final composted product. Seven bracing struts prevent the container from collapsing after soil is backfilled around it. Other parts of the system include a porcelain toilet bowl and plastic mock cistern specially designed to be used without water, an agitator rod (connected to the handle on the mock cistern and a paddle which is designed to break up the faecal material on the main grid), air inlet ducts, an air extractor duct, a windmaster unit and an inspection manhole. Additional details regarding the operation of the Enviro Loo latrine are provided in Appendix A.

2. PROJECT AIMS AND PROJECT STUDY TEAM

The major aims of the research project were:

- to monitor the operation of 30 Enviro Loo latrines over a period of 12 months (June 1996 - May 1997) in an urban informal settlement area;
- to assess the efficiency and effectiveness of the technology;
- to determine the health impacts of the latrines; and
- to evaluate user acceptance of the technology.

Several organisations were actively involved in the project. The GJMC funded the capital costs for the purchase and installation of the latrines. Stewart Scott Incorporated was appointed to co-ordinate and conduct the project. The GJMC's Wastewater Sub-Cluster, which is involved in the

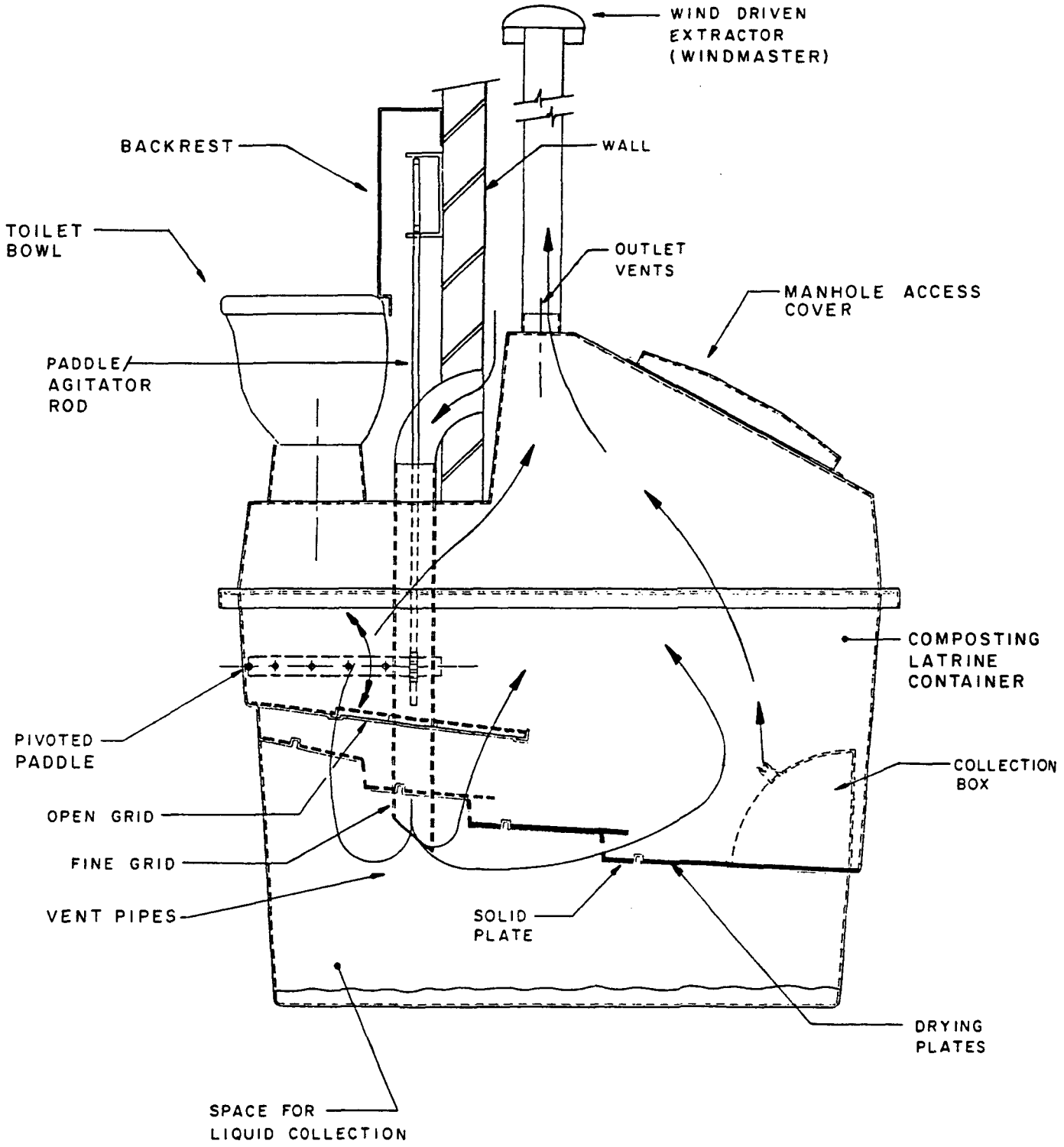


Figure 1 : Diagrammatic View Of Enviro Loo Latrine

provision of sanitation services to informal settlements in the Johannesburg area, provided logistic and maintenance support to the project, whilst the Health and Scientific Services Branch tested samples of faecal waste at the end of the trial and assisted in monitoring the performance of the latrines throughout the duration of the trial. Furthermore, the GJMC's Epidemiology and Health Information Systems Sub-Cluster investigated the health aspects of the latrines by evaluating, amongst other factors, the incidence of relevant sanitation related diseases amongst households in the chosen trial area. The developers of the Enviro Loo, Enviro Options (Pty) Ltd, also provided the project team with technical back-up and support in terms of the correct installation and maintenance of the latrines, as well as providing user information and education.

A key component of the project was the involvement, from the outset, of the local community living in the settlement selected to partake in the trial - viz Elias Motsoaledi (also known as Baralink) outside Soweto (see Figure 2). Two members of the settlement's Community Development Forum were employed to assist in the monitoring of the latrines, to act as a communication channel between the community and the project team and to inform the project team of any problems in the settlement which might affect the project. Local unemployed labour was used to install the latrines and construct the superstructures (see photographs in Appendix B) at the commencement of the project (April 1996).

3. RESEARCH METHODOLOGY

The basis for assessing the Enviro Loo latrines in the research project revolved mainly around the information obtained from two sets of households in the chosen community - ie the 30 households using the Enviro Loo latrines (the Study Group) as well as 30 households (the Control Group) using the alternative form of sanitation in the informal settlement (viz communal chemical latrines). Information from the Control Group was also collected in order to provide an indication of the general level of health of the community, as well as perceptions regarding the use of the communal chemical latrine system presently provided to the settlement. The two groups of households were selected in consultation with the community in six discrete blocks of five for each group, the details of which are provided in Appendix C. From both a health and a technical perspective, data collection was undertaken using two types of questionnaire (a background questionnaire and a routine monitoring questionnaire).

The background questionnaire (see Appendix D, questions 1-12) was administered to both the Study Group (the Enviro Loo latrine users) and the Control Group (the communal chemical latrine users) at the outset of the monitoring programme (May 1996) in order to acquire certain baseline

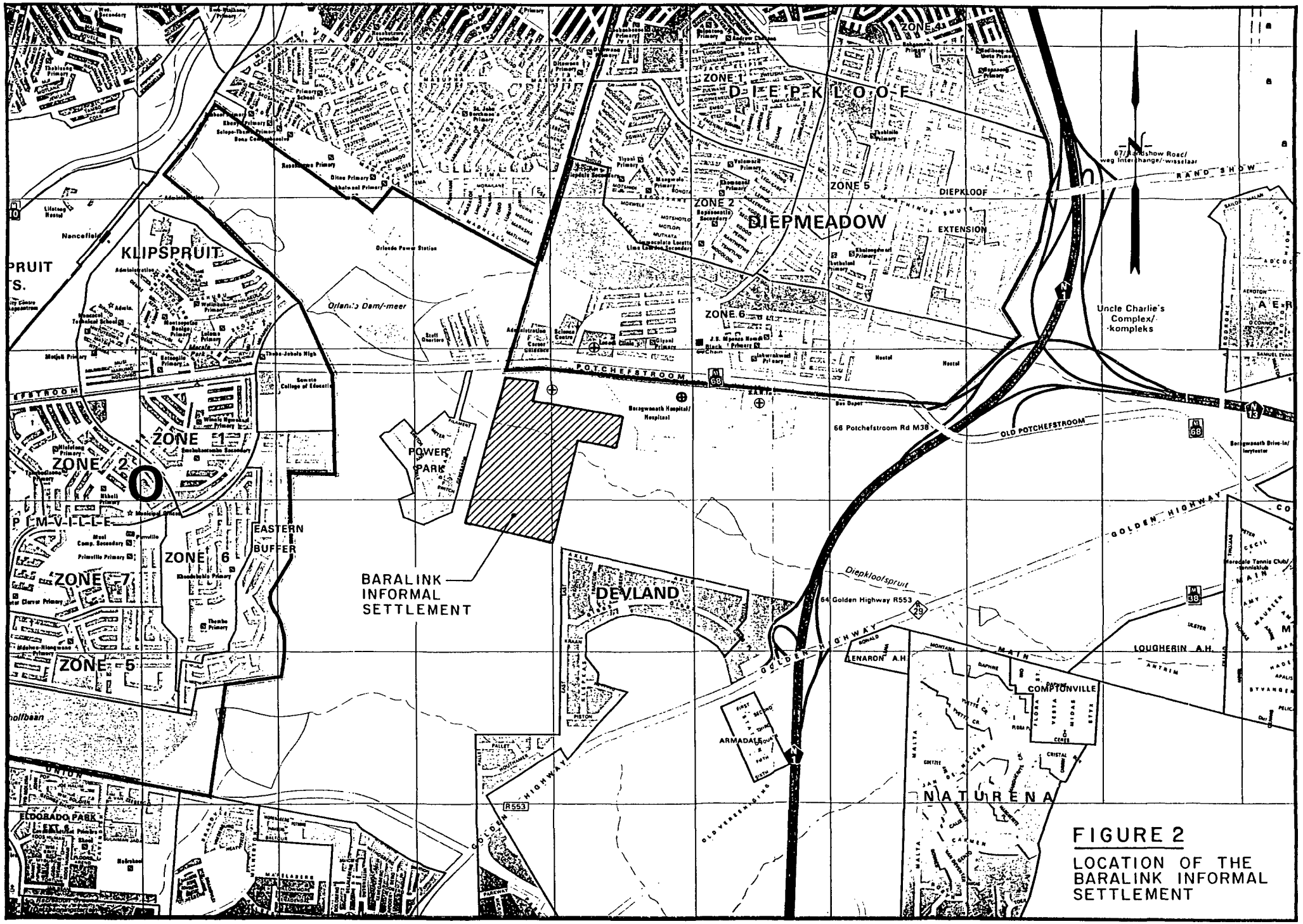


FIGURE 2

LOCATION OF THE BARALINK INFORMAL SETTLEMENT

information regarding the households partaking in the study, their health status, sanitation practices and knowledge. This part of the questionnaire was administered again during November 1996 in order to establish whether the characteristics of the participating households had altered in any significant way. No significant changes were observed and the results (see Appendix E) were considered sufficiently stable to permit interpretation of the trends identified in the routine monitoring questionnaire. This baseline data on household demographics and socio-economic characteristics also facilitated understanding and meaningful interpretation of the study findings.

With regard to health and technical aspects, data was collected via the routine monitoring questionnaire (see Appendix D, questions 13-24) and this questionnaire was administered approximately every fortnight over the 12 month study period. Information was collected regarding health on the following factors: a) the incidence of acute diarrhoeal disease, since it is widely accepted as an indicator of the quality and adequacy of sanitation facilities in a community; b) the incidence of acute respiratory disease as it can be a major confounding factor; and c) the anal cleansing materials used and the presence of sanitation related nuisances, specifically flies and unpleasant smells. Additional information was also obtained from the Study Group regarding specific knowledge on how the Enviro Loo latrines function and the level of satisfaction, including perceived safety, with the Enviro Loo latrine as a sanitation facility.

In monitoring the health impacts of the latrines, two main factors were considered - viz the identification of health aspects which were both measurable and related to sanitation and the use of cost-efficient and practical methods of data collection taking into account the logistical problems of informal settlements. It must be remembered, that the incidence of diarrhoea is only one indicator of the quality and adequacy of sanitation facilities in a community. Acute diarrhoea can have many causes such as inadequate drinking water, poor preparation of food, unhygienic personal habits etc. It should also be recognised that no health data were evaluated on the general level of health in the chosen community prior to the trial. It must thus be stressed that the incidence of diarrhoea disease in the Study and Control Groups was used as a proxy measurement which merely gives an indication of the health impacts of the sanitation systems under review.

As part of the routine monitoring questionnaire, responses from the Study Group were also sought regarding the physical condition and performance of the Enviro Loo latrines. This information was supplemented by field observations made by the project team during visits to the settlement, whilst observations of the contents of the latrine containers were made on a regular

basis when the inspection manhole covers were opened in order to record ambient air temperatures inside the containers (see Appendix F). Relevant weather data were also obtained to monitor the effects, if any, of meteorological conditions.

All completed questionnaires were screened, coded and captured on computer by the Epidemiology and Health Information Systems Sub-Cluster of the GJMC. An Epidemiology software package (Epi-Info 6) was used to analyse the health data, whilst a spreadsheet was used to evaluate the technical data.

At the end of the trial period (June 1997), all 30 Enviro Loo latrines were inspected and the temperature and pH of the waste piles recorded together with visual observations of the waste and the general condition of the latrines. Samples were taken from waste in six randomly selected Enviro Loo latrine containers, and these were tested for a range of microbiological and chemical parameters.

4. USER EDUCATION AND INSTITUTIONAL SUPPORT

User education was considered essential prior to commencement of the trial to ensure correct use of the Enviro Loo latrines. Households using an Enviro Loo latrine received education regarding its workings at the outset of the project, and an additional education session was held after six months of operation. The regular administering of the routine monitoring questionnaire also helped to reinforce the correct usage of the latrines. An example of user education literature provided by Enviro Options is shown in Appendix G.

Under ideal conditions, the Enviro Loo latrine technology requires the preferable (though not obligatory) use of toilet paper as an anal cleansing material, the use of an organic toilet cleaner (which will not kill the bacteria responsible for breaking down the faecal matter in the latrine) and the periodic addition of compost to assist the biological process. No additional waste nor water should be disposed of into the Enviro Loo latrine as this can detrimentally affect the breakdown of the faecal matter.

Full technical maintenance and support was provided free to the Enviro Loo latrine users by the GJMC and Enviro Options during the course of the trial. This included the free supply of organic

toilet cleaner, compost (sourced from composted sludge from Johannesburg's Northern wastewater treatment works) and starter enzyme (the latter is used at the start of the composting process to initiate the biological process in the latrine container). Toilet paper was supplied on a limited basis by the GJMC to the community irrespective of whether the household was using an Enviro Loo or chemical latrine. Mechanical or operational problems with the Enviro Loo latrines, however, were attended to during the course of the project where they severely affected the functioning of the latrine.

5. RESULTS

- The **costs** (inclusive of VAT) of purchasing and installing the Enviro Loo latrines and their associated superstructures (at April 1996 prices) were as follows:

Enviro Loo units (30)	R 78 660.00
Superstuctures (30)	R 26 942.80
MATERIALS SUB TOTAL	R105 602.80
Construction and Installation Labour	R 41 102.70
Supervision	R 7 654.90
LABOUR SUB TOTAL	R 48 757.60
GRAND TOTAL	**R154 360.40**

The costs of purchasing the 30 Enviro Loo latrines amounted to R2 622-00 per latrine (including VAT), whilst the installation and superstructure costs, using local labour, amounted to R2 523-75 per latrine (including VAT).

The total installation and construction costs per unit thus amounted to R5 145.35 per latrine. It should be noted that operational and maintenance costs were **not** recorded or analysed during the course of the trial as support and maintenance services were provided free of charge by the GJMC and Enviro Options.

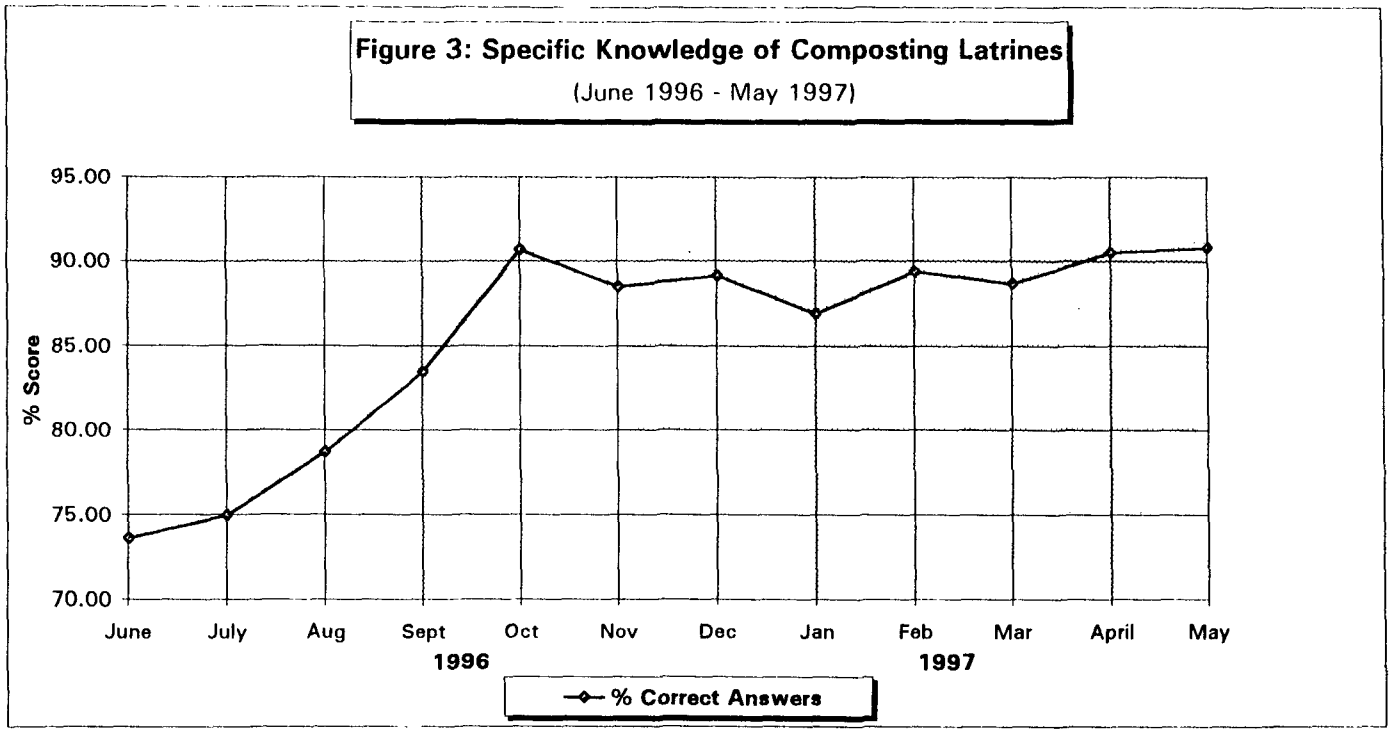
- With the exception of the agitator rod (or paddle) mechanism (see below), the **physical integrity** of the Enviro Loo latrines stood up well to use over the 12 month trial period. Some subsidence of ground occurred during the year around a few of the latrines which resulted in the inward bulging of the latrine container sides. This is thought to be mainly attributable to the failure to adequately compact the ground around the latrines during installation or as a result of insufficient stormwater control on the site. Minor problems were also experienced with some toilet doors which did not close well and two windmasters which did not easily turn in very light wind conditions. None of these minor problems proved to be fatal flaws.

- A design fault with the **agitator rod mechanism** (which breaks up and dislodges the fresh faecal pile on the upper grid in the latrine container) became apparent in up to one third of the latrines during the early months of the trial. This problem also coincided with an increase in complaints about flies and unpleasant smells from the Enviro Loo latrine users. The failure of the agitator rod led to a build up of faecal material on the upper grid, which was visible to and offended latrine users whilst attracting flies down the toilet bowl. This latter problem may have been accentuated by the fact that the toilet bowls installed in the latrines were of the ceramic type which more readily reflected light into the latrine container. The complaints received from users in this regard led to a decision by the project team to replace the agitator rod in all the Enviro Loo latrines with an alternative mechanism which was designed by the developers of the latrine. This alternative design involved a more robust agitator rod to which was attached a flap that could be closed beneath the toilet bowl by the agitator rod handle at the same time as breaking up the faecal pile on the upper grid in the latrine container. The new design thus not only acted to break up the faecal pile, as was the intention with the original design, but also helped to alleviate the visual impact of faecal matter build-up on the upper grid, as well as helping to prevent access to the latrine container by flies. The new agitator rod mechanism was retrofitted in November 1996 (halfway through the trial) after receiving the approval of the households using the Enviro Loo latrines. The retrofitting of the new mechanism could not be custom designed for the installed latrines and the new agitator rod worked better in some latrines than in others according to the neatness of fit achieved during the replacement exercise. Nevertheless, a noticeable fall in complaints about both flies and unpleasant smells amongst most of the Enviro Loo latrine users (see below) occurred after the retrofitting of the agitator rod. The developers of the Enviro Loo latrine have subsequently incorporated the modified agitator rod mechanism into their latrine design.

- Although just a single roll of toilet paper per fortnight is supplied by the GJMC to the households living in the informal community of Elias Motsoaledi, a high use of toilet paper as an **anal cleansing material** was recorded throughout the trial period amongst the Study Group (85% on average). A combination of toilet paper and newspaper was used by 14% of respondents and just 1% used newspaper only. Amongst households in the Control Group, an average of 39% used toilet paper only, 46% used a combination of toilet paper and newspaper and 15% used newspaper only. The usage trends of anal cleansing materials were consistent for both groups throughout the trial period and reflect the high use of toilet paper, particularly amongst the Study Group. The latter trend was reinforced by the user education received by households in the Study Group, but even amongst the Control Group, a high usage of toilet paper suggests many households in the community are purchasing toilet paper in addition to the supplies distributed by the GJMC. During the course of the trial, the project team established that toilet paper is sold and regularly bought at spaza shops in the community.

- The routine questionnaire was used as a means to evaluate **knowledge** amongst the Study Group regarding the **correct usage of the Enviro Loo latrines** (see Figure 3). Such knowledge included the regular and proper application of organic toilet cleaner and compost. It was found that users generally showed a good understanding of how the Enviro Loo latrine should function. An improvement in knowledge was noted during the winter period of 1996, which was sustained throughout the summer period of 1996-97 with 85-90% of respondents on average correctly answering questions on these matters. The regular questioning of respondents on these issues together with the user education sessions held at the outset of the trial, and again after six months, contributed to this improved knowledge. It should be noted, however, that although the users displayed a good knowledge about the latrine, this was not always put into practice leading to the disposal of wastewater in some latrines (see below).

- The presence of excessive quantities of water in the toilet containers of up to 10 (one third) of the Enviro Loo latrines during the course of the 12 month trial period stressed the **importance of both user education and stormwater control**. The amount of water found in the containers varied and in five instances, the volume of water was substantial. In the case of these latter latrines, restoration of the proper functioning of the toilets required the pumping out of the water either by the GJMC or Enviro Options. Investigations into these occurrences revealed that washing up or bath water ("grey water") was disposed of into the latrine either by household members who did not understand the education received in this regard, or, as



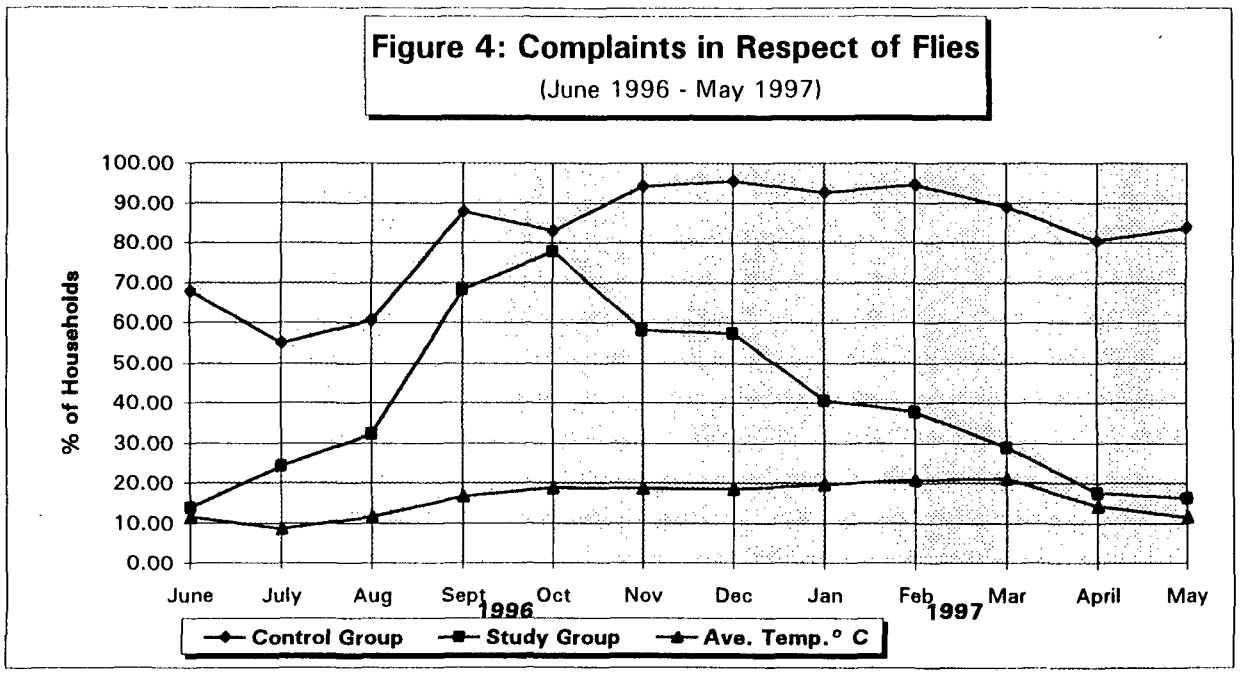
	1996							1997				
Specific Knowledge:	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**April**	**May**
% Correct Answers	73.60	74.95	78.68	83.45	90.70	88.50	89.15	86.90	89.40	88.70	90.50	90.80

appeared more likely, by visitors who were unaware of the requirements of the latrine. The latrines which contained smaller volumes of water was mainly the result of stormwater ingress. The stormwater either penetrated the container as a result of poor drainage on site or as a result of rainwater entering the cubicle from above and/or below the toilet door. In the latter case, the rainwater flowed into the latrine container via holes in the floor slabs made during the retrofitting of the agitator rods. The prolonged rainstorms in the study area during the late summer (March 1997) were largely responsible for the problems in this regard.

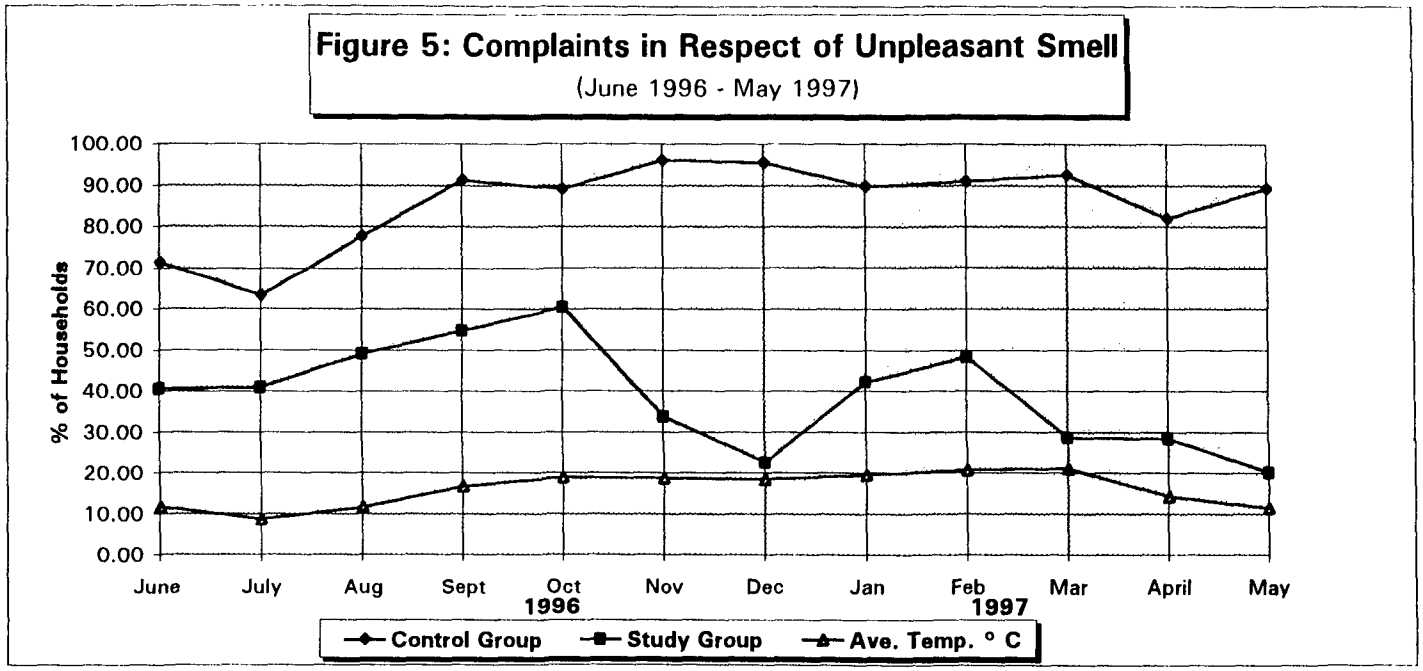
- The **incidence of diarrhoea and respiratory diseases** amongst the Study and Control Groups was used as a means to assess the health impacts of sanitation provided in the Elias Motsoaledi community. It is **incorrect to directly compare the incidence of diarrhoea and respiratory diseases amongst the two groups**, since the Enviro Loo latrines are being used on single stands whilst the chemical latrines used by the Control Group and the rest of the community are a communal form of sanitation. The results (see Appendix H) do indicate, however that **no adverse or unexpected health impacts from the use of Enviro Loo latrines were detected during the course of the trial** when viewed against the general level of health prevailing in the rest of the community. Diarrhoea disease was defined as the presence of three or more loose stools within a 24 hour period whilst the incidence of respiratory disease, which is commonly associated with diarrhoea motions, assisted in interpreting the occurrence and severity of diarrhoea disease. The incidence of diarrhoea amongst households in the Study Group showed a decrease during the first months of the trial period followed by peaks in the months of November 1996 and January 1997 and then a gradual decrease again until the end of the study. Operational difficulties with the agitator rod and warmer weather and seasonal outdoor activities associated with the summer period can be ascribed to the peaks in diarrhoea disease observed amongst the Study Group. A similar trend was discernible amongst the Control Group. More variation was observed in the incidence of respiratory disease amongst both the Study and Control Groups, although the incidence was generally lower for both groups during the summer months. The overall incidence of diarrhoea and respiratory diseases was generally higher amongst the Control Group, but since this group started off with a higher baseline incidence for both diseases, it is not possible to draw any further conclusions.

- Although data was not collected on **the severity of diarrhoea and respiratory illnesses,** the study results show that most diarrhoea and respiratory diseases contracted by respondents in the Study and Control Groups during the course of the trial were of a mild nature since they were cleared with either self medication or without treatment. Incidences of a more severe degree were largely cured by medication received after a visit to the local clinic. The age distribution of respondents contracting diarrhoea and respiratory diseases showed that adults became ill more frequently than children under 5, despite the fact that the latter is the more susceptible age group. This can be explained by the fact that adults constituted the bulk of household members in both the Study and Control Groups. When the data is correlated to the overall age population distribution with the two groups, however, the frequency of diarrhoea and respiratory disease remains high amongst children under 5.

- Complaints from respondents in the Study and Control Groups in respect of **flies and unpleasant smells** (Figures 4 and 5) were used by the project team as an indicator of the performance of the latrines, as well as an additional parameter for evaluating the health impacts on the respective latrine users. Once again, a direct comparison should not be drawn in terms of the number of complaints of flies and unpleasant smells recorded by respondents from the Study and Control Groups since the Enviro Loo latrines and the communal chemical latrines were operating under different conditions. The number of complaints in respect of flies increased for both the Study and Control Groups with the onset of the summer season, although the increase in the Study Group was more marked, since it came off a lower base. From November 1996 until the end of the study, complaints in respect of flies fell amongst the Study Group whilst remaining consistently high amongst the Control Group. The fall in the number of complaints amongst the Study Group is attributed to the retrofitting of the new agitator rod. A similar trend is discernible with regard to complaints of unpleasant smells, although in this case the fall in complaints from the Study Group after November 1996 was interrupted by an increase in January and February 1997. This anomaly is attributed to problems experienced with certain of the retrofitted agitator rods which were not functioning properly. It would be expected that the Enviro Loo latrines which are located on single stands would be more cared for and maintained by the individual owners than the communal chemical latrines used by a number of households. The results for the Study Group, however, show that completely fly and odour free operation was not attained during the trial period.



	1996							1997				
	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Control Group	67.86	55.10	60.61	87.90	83.10	94.25	95.50	92.60	94.60	88.90	80.40	83.90
Study Group	13.93	24.29	32.26	68.27	78.00	58.20	57.50	40.70	37.80	28.90	17.60	16.40
Ave. Temp.° C	11.60	8.70	11.70	16.80	18.90	18.80	18.50	19.60	20.80	21.10	14.30	11.50



	1996							1997				
	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Control Group	71.25	63.27	77.70	91.26	89.15	96.15	95.50	89.70	91.00	92.60	82.00	89.30
Study Group	40.64	40.93	49.10	54.77	60.40	33.80	22.70	42.30	48.30	28.70	28.30	20.20
Ave. Temp. ° C	11.60	8.70	11.70	16.80	18.90	18.80	18.50	19.60	20.80	21.10	14.30	11.50

- At the end of the trial 12 month period, the Enviro Loo latrine users were asked for their **opinions** about the latrines. Their responses are summarised below:

	RESPONSE	%
Performance of Latrine	**Satisfactory**	**53,7**
	Satisfactory subject to rectification of operational problems *	**42,7**
	Unsure	**3,6**
Preferred Aspects of Latrine	**Safety**	**44,0**
	Privacy	**24,1**
	Accessibility	**24,0**
	Cleanliness	**7,9**
Unfavourable Aspects of Latrine	**None**	**40,0**
	Does not flush	**40,0**
	Flies and unpleasant smells	**16,7**
	Floods	**3,3**

* Operational problems included the agitator rod, toilet doors and stormwater control

Table 1 : Opinions about Enviro Loo Latrines from Users

It can be seen that users were generally satisfied with the performance of the Enviro Loo latrines, although for some this was subject to the rectification of certain operational problems which emerged during the trial. Preferred aspects of the sanitation system included safety, privacy, accessibility and cleanliness. The aspect of safety not only covered the safety of the latrine itself, but also the physical safety associated with access to the latrine (ie it was on the household's stand and did not require a walk to a communal chemical latrine). Unfavourable aspects of the latrine included that it does not flush (reinforcing the perception held by many urban informal settlement dwellers that waterborne sanitation is preferable), flies and unpleasant smells and problems associated with stormwater control.

- The **ambient air temperatures** inside the Enviro Loo latrine containers were recorded on several occasions during the trial period between 08.00 and 14.00 when the manhole covers were opened for inspection. Temperatures inside the containers were measured by hanging a thermometer in the container and closing the manhole cover and then waiting for the temperature reading to stabilise. Average temperatures inside the containers fell below 10^0C during the winter and climbed to over 26^0C during summer. The temperatures did not, however, reach over 50^0C, the minimum temperature desirable for the killing of all pathogens within the waste material. Although the method used to measure the temperatures was not ideal (temperatures inside the faecal mass within the closed container would be preferable), further research in this area is required before any firm conclusions can be drawn.

Temperatures inside the faecal mass were measured by a temperature probe at the end of the trial during June 1997 (winter) and averaged just 5^0C. The low temperatures could be ascribed to a combination of the winter season and the small volume of the waste pile in the containers, and were also influenced by the measuring technique adopted.

- The **waste** which accumulated inside the container during the trial period remained small in volume and largely confined to the upper grid (see Photographs in Appendix I). In no container had the waste reached the bottom (third) grid (where the collection box is situated) in sufficient quantities for removal. In some instances, however, waste had fallen onto the middle or second grid. The waste appeared quite moist in the centre of the upper grid (where fresh faecal material was falling), but drier at the edges (where the application of compost could be discerned - ie the presence of partially decomposed woody or straw material was visible). Toilet paper and newspaper were still clearly identifiable, but no other anal cleansing material was recognised. Apart from the odd piece of plastic or cloth, no other waste material was observed inside the latrine containers.

- All temperature readings (see Appendix J) in the waste piles taken at the end of the trial were low (average 5 ^{0} C) and comparable to air temperatures inside the container (ie between 2 and 10^0C). Although taken during the winter season, such temperatures indicate that conditions in the container are unfavourable at this stage with regard to both encouraging biological activity and the killing of pathogens. Since the waste pile is small, any heat produced by microbial activity is quickly dissipated. pH readings were between 7,0 and 8,8 indicating neutral or alkaline conditions favourable to aerobic decomposition (an acidic pH would be generated by acid fermentation products under anaerobic conditions).

- In essence the **analysis of the waste samples** (see Appendix J) taken from 6 of the Enviro Loo latrine containers in June 1997, just over 12 months after the commencement of the trial, indicated that, in general, the composting process was insufficiently advanced to allow utilisation of the material for compost. It would appear that the system's ability to compost the human excreta is limited and requires a longer period, or the waste material needs to be further composted in order to make it safe and usable.

- The **visual observations** of the waste samples made prior to the microbiological analysis indicate that most samples taken from the top grid were moist. Waste taken from the edges of the first grid or second grid tended to be drier. The waste was generally very dark in colour. Biological activity in the form of fungi, mites and larvae were observed under a microscope.

- In the **microbiological analysis of the waste samples,** non or poor compliance was recorded with the recently published guidelines (WRC, 1997) for the permissible utilisation and disposal of sewage sludge in terms of *Faecal coliforms* (<1 000 coliforms per 10g) and *Ascaris* (no visible *Ascaris* ova per 10g) viability. A single sample met the guidelines for F*aecal coliforms* and none with any certainty for *Ascaris* ova. No *Salmonella* was detected, however. The waste was generally indicated as aerobic. Anaerobic conditions may occur if the pile is not sufficiently mixed by the agitator rod. An increase in *Faecal coliform* numbers appears to be promoted by movement of the waste from the top to the second grid. Residue time in the container, the presence of ample nutrients in the waste and the presence of sufficient moisture are possible reasons for this increase. Drying of the waste only occurs at the grid edges as urine and wastewater tend to travel down the centre of the waste pile on to the next grid. A significant decrease in *Faecal coliforms* is achieved during the drying process. Further decreases could be expected in the final product. For the complete destruction of the *Ascaris* ova present, a temperature of at least 50 ^{0}C for 60 minutes is required. Based on the ambient air temperatures recorded in the containers, even during the summer months, achieving these conditions appears unlikely at this stage. Should current trends persist, the final composted product may thus contain viable *Ascaris* and will therefore require some form of secondary treatment prior to disposal or use as a soil conditioner or compost.

- In terms of the **chemical and metals analyses,** the potassium, nitrogen and phosphorus content indicated the suitability of the waste material as a soil conditioner. For the samples analysed, total phosphorus and nitrogen levels were comparable to the average levels found in the compost produced from the Northern wastewater treatment works (and added to the Enviro Loo latrines during the trial). Potassium levels are consistently higher, however, than the compost average. The variation in concentrations for all three of these parameters may be the result of the amount of compost added to the composting latrines and household members diet (especially in the case of potassium). Ammonia and ortho-phosphate are naturally present in human waste and their concentrations will in time affect the final nitrogen and phosphorus levels in the waste. This will be important in terms of what applications the waste can finally be used for. Metal concentrations in the samples were higher than anticipated, although the results correlate with the metal concentrations found in the compost from the Northern wastewater treatment works (which was added to the Enviro Loo latrines on a regular basis during the trial). Some of these metals are essential trace elements in the human diet (eg copper, zinc, selenium) whilst metals are also present in vegetables, the relative concentrations being dependent on soil concentrations and the soil solubility of

individual metals. The acceptability of the samples for unrestricted use as compost will also be limited by metal concentrations which do not comply with the (WRC, 1997) guideline limits. In the waste samples analysed from the Enviro Loo latrines, concentrations significantly exceeded the guidelines for lead and zinc. The chemical and metal analyses appear to show that the waste in the latrine containers is strongly dominated by the compost added from the Northern Wastewater treatment works.

6. CONCLUSIONS

The Enviro Loo latrine trial project in the Elias Motsoaledi informal settlement has provided a platform and a benchmark against which to evaluate further investigations into this dry, on-site sanitation technology. As happens in many pioneering research studies, the project has raised new questions and issues requiring further research.

The limited scope of this project, in that the trial was conducted under urban informal settlement conditions on single stands and with full local authority support, means that it is not possible to state with any certainty whether the technology would operate successfully on a large scale under other South African conditions (eg in rural areas, where education levels are generally lower, local cultural customs stronger and where there may be little or no support from the authorities).

Nevertheless, the results from this trial project indicate the following:

- With the exception of the agitator rod, the **physical performance** of the composting latrine over the 12 month trial period was satisfactory. The failure of the agitator rod in up to one third of the test latrines emerged as a design fault, which was subsequently investigated by the latrine developers and the relevant part modified and improved.

- **Minor problems** noted during the course of the trial with ill-fitting toilet doors, windmasters and stormwater management can be addressed with further field experience and instruction and training during installation and construction. Such issues are practical considerations which can affect all similar sanitation options and do not undermine the technical performance of the Enviro Loo latrine per se.

- The importance of **user education** when introducing a new sanitation technology such as Enviro Loo latrines appears critical. Despite user education sessions and a high level of

knowledge amongst the latrine users about how the composting latrine functions, problems with grey water disposal into the latrines and to a lesser extent stormwater management, manifested themselves during the trial. These problems rendered a significant number (one third) of the latrines inoperable in terms of the composting process. Water in the latrines not only promoted anaerobic conditions, but also required pumping out to restore operation of the composting process in the latrines. These incidents highlight **user education and maintenance issues** which would have to receive attention should the technology be introduced on a large scale. They also indicate that the latrines are not entirely maintenance free and will thus still require some form of institutional support.

- **Complaints about flies and unpleasant smells** by users of the composting latrines were recorded during the trial. Many of these complaints appear to have been associated with the failure of the agitator rod mechanism. Claims of completely fly and odour free operation for any dry sanitation system are, in the opinion of the project team, probably unrealistic.

- **No adverse health impacts** were identified during the trial which could be associated with use of the composting latrines, although it must be noted that no baseline health data on the general health of the Elias Motsoaledi community were collected prior to the study.

- The **high use of toilet paper** as an anal cleansing material (and newspaper as an alternative) in the Elias Motsoaledi urban informal settlement is an interesting finding. It provides evidence, given a free choice in these settlements, of a move away from the use of more traditional anal cleansing materials (eg mielie cobs and stones) together with an ability to afford alternatives (ie toilet paper and newspaper). The user education sessions for the composting latrine users, which emphasised preferable use of toilet paper as an anal cleansing material appear to have been successful.

- It appears that, **after 12 months, there is little evidence of biological activity in the Enviro Loo latrines and the composting process is not well advanced.** Although aerobic conditions appear to be present in the waste pile, no significant degree of composting has taken place. Doubt also exists as to whether sufficiently high temperatures are being attained in the waste pile to consistently destroy pathogens. The impact on composting of the uneven distribution of moisture in the waste pile is also uncertain, since the centre of the waste pile in nearly all the composting latrine containers is very moist whilst being much drier at the edges. The important interactions between moisture and temperature which facilitate biological breakdown and the composting processes do not appear to be taking place. The relatively

rapid breakdown of organic waste commonly seen in garden compost heaps has not occurred in the Enviro Loo latrine containers. Faecal waste and anal cleansing material is visible in more or less its original state. Furthermore after 12 months, the waste pile is still small and largely confined to the upper grid which makes any assessment of this important part of the technology difficult and premature. The slow rate of breakdown indicates that, without further treatment, the waste pile could not be safely applied as an organic fertiliser or soil conditioner after 12 months since potentially harmful microbiological contamination remains in the waste.

7. RECOMMENDATIONS

Although the Enviro Loo latrines performed adequately as a toilet and as an alternative to communal toilets over the 12 month trial period, certain questions regarding the technology remain unanswered. In order to acquire an improved and more rigorous scientific understanding of this sanitation option, therefore, it is recommended that:

- The 30 Enviro Loo latrines installed at the Elias Motsoaledi settlement **continue to be monitored** on at least an annual basis (and preferably more regularly) in order to :

  - assess the physical performance of the latrines over a longer period of time;

  - determine the user acceptability, affordability and appropriateness of the technology in this type of settlement;

  - investigate the level of user education, maintenance and institutional support required to keep the latrines operational (and an assessment of the costs associated with this); and to

  - evaluate the composting process inside the latrine containers over a longer period of time as the waste pile grows bigger.

- The information obtained through the above exercise could also be **supplemented** by an evaluation of other Enviro Loo latrines which have been installed in the field for longer periods of time in different locations around South Africa and under different operational conditions.

- Further investigations are also recommended into the need for and type of **subsequent treatment** required for waste material which is ultimately removed from dry sanitation systems in order to make its further use beneficial and safe.

- As a result of the limitations of the trial at Elias Motsoaledi settlement, particularly in terms of the transferability of the findings to other sanitation provision situations, it is recommended that a **more extensive trial** of Enviro Loo latrines be conducted in varying conditions alongside other similar dry sanitation technologies. This would facilitate direct comparison of the sanitation systems and overcome the limitations and constraints of this study. Varying conditions could include communal and single-stand use, urban and rural situations and the provision of full or limited support and maintenance. Absolute cost and cost recovery issues, and other health, financial, institutional, environmental, socio-cultural and technical considerations would also need to be fully assessed. It would be important to obtain consensus from the various stakeholders with an interest in sanitation regarding the protocol for such a trial in order to agree on what should be tested. This would help satisfy the divergent views and perceptions held about dry sanitation systems.

Once the above steps have been undertaken, the specific role which could be played by composting latrines could be defined with more accuracy and would allow for the objective selection of this technology with respect to other sanitation options.

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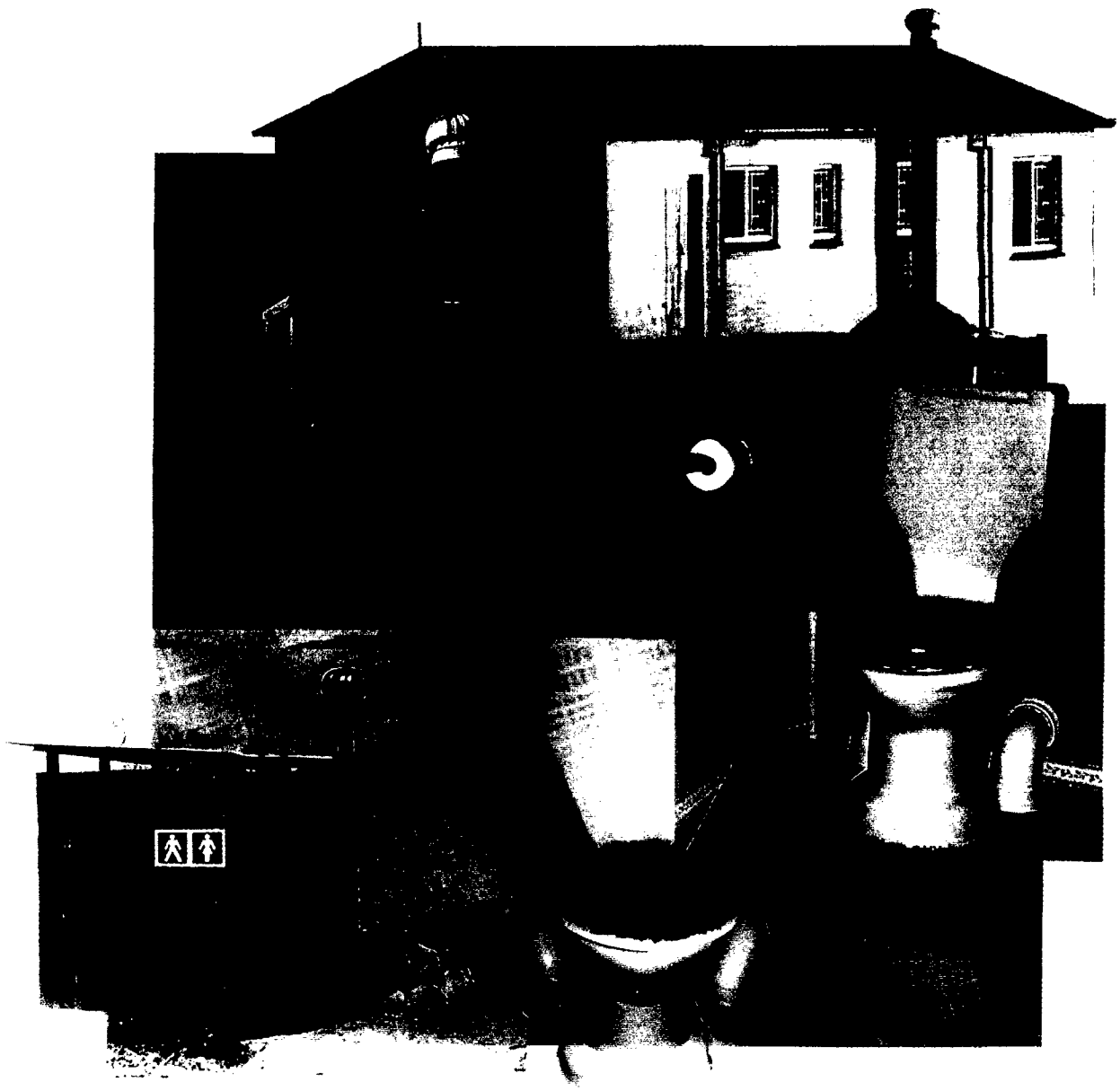
APPENDIX A

DETAILS OF THE ENVIRO LOO SANITATION SYSTEM

ENVIRO OPTIONS

AN EFFECTIVE SANITATION SOLUTION



ENVIRO LOO

THE NON-FLUSH DRY SANITATION SYSTEM

THE NON-FLUSH COMPOSTING TOILET

WHY WASTE OUR PRECIOUS WATER RESOURCES TO TREAT HUMAN EXCREMENT. NATURE CAN TREAT IT FOR YOU. RECYCLE BACK TO NATURE AND HELP SAVE THE ENVIRONMENT

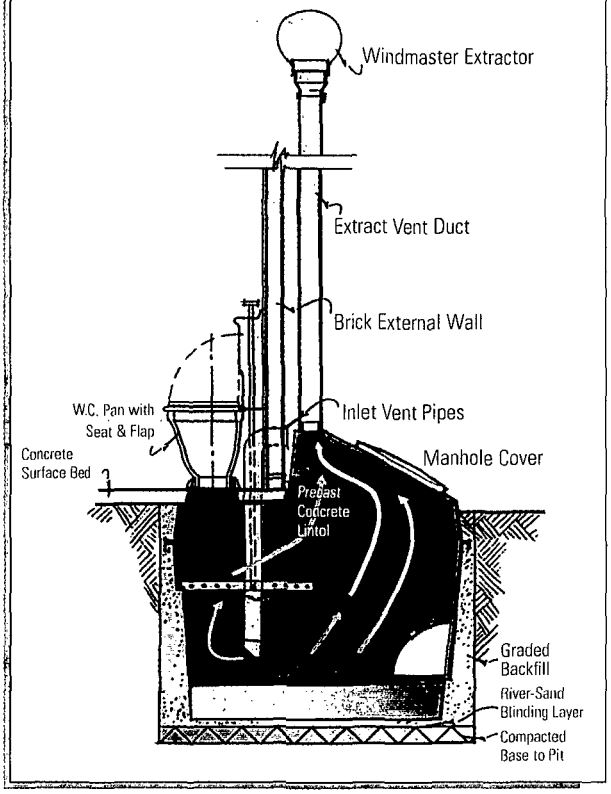
THE PROBLEM

- Africa is a water-poor continent which makes the utilisation of waterborne sanitation an unrealistic option in most areas.
- The capital cost required for waterborne sanitation is prohibitive in the majority of situations.
- It has been conclusively proven that nitrate loaded effluent from Pit latrines is directly responsible for the widespread contamination of valuable groundwater resources.
- The regular operating and maintenance costs for sanitation systems such as bucket latrines, chemical toilets, septic tanks and waterborne are very high.

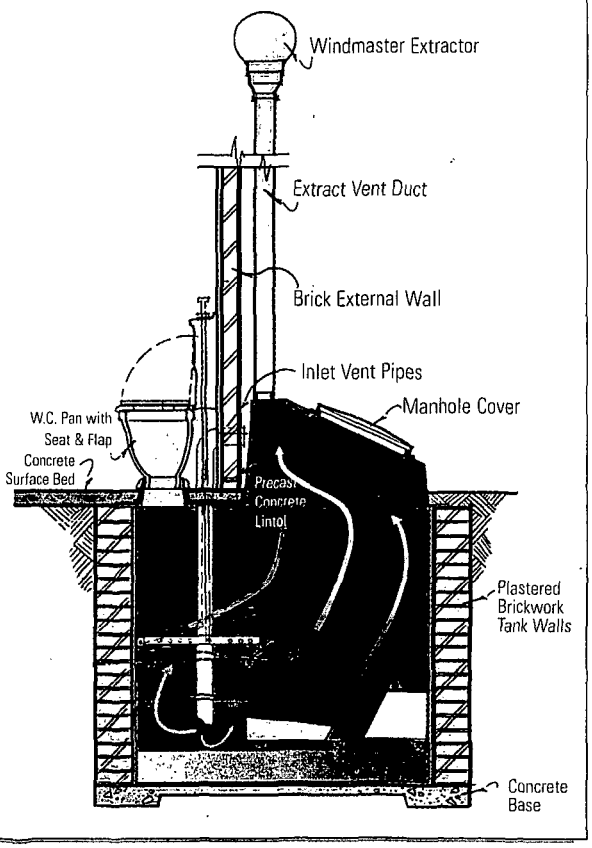
ADEQUATE SANITATION

- A respectable and hygienic system that meets the health and functional requirements of all users and Governmental Authorities.
- It must not pose any risk of pollution to the surrounding environment or valuable groundwater resources.
- It must satisfy the dignity of all users.
- The system should require minimal water usage and operate effectively.
  The system should require minimal operational and maintenance expenditure.

SECTION-PRE-FABRICATED TANK



SECTION- BRICKWORK TANK



THE ENVIRO LOO SOLUTION

Designed for the benefit of all communities.

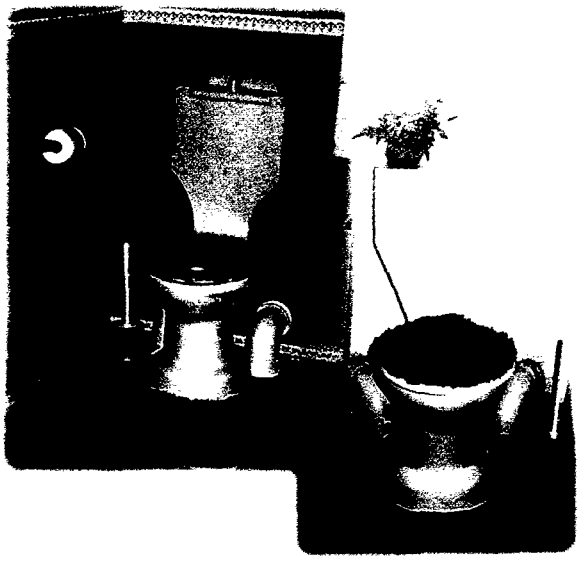
- The system does not use water.
- Uses no chemicals.
- A closed circuit system.
- No flies.
- Completely odourless.
- No power required.
- Minimum monthly operating costs.
- Indoor installation.
- No sewage seepage into the surrounding groundwater reserves.
- No expensive sewage treatment plants required.

ENVIRO LOO TECHNOLOGY

- Dr B. E. La Trobe utilised bacterial and biological Technology plus Expertise gained in Research and Development in Waste Management to develop the Enviro Loo composting sanitation system.
- Widespread experience with the system in South Africa has demonstrated that it is a cost-effective, respectable, hygienic and environmentally friendly sanitation system that satisfies the dignity of all users.
- The Enviro Loo operates by separating the liquid and solid waste. The system ulilises radiant heat and adequate ventilation through the waste in the sealed container to convert human excrement, via the stimulated bacterial and biological activity, into an inoffensive compost like material.

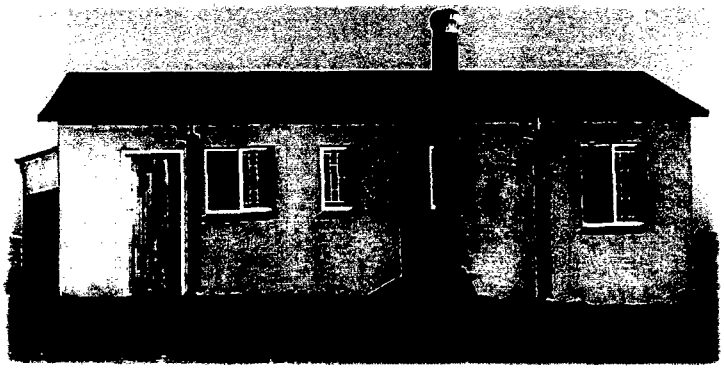
HOW IT WORKS

- The body waste falls onto a bed of organic matter on the grid. The aerator which has been designed for ease of operating, breaks up the solid waste to ensure proper aeration and drying.
- As the waste dries and decomposes, the dried matter falls from the grid onto the drying plates and in time travels down the plates towards the collection box.
- A uniquely designed ventilation system allows air to be drawn into the container and through the waste.
- Air is exhausted from the container with the assistance of the ventilation extraction system.
- A manhole is positioned above the collection box to ensure easy access for the periodic removal of the humus. (Dried waste.)



APPLICATIONS

- Domestic, both peri urban and rural



- Holiday Cottages
- Farms
- Game Farms
- Walking Trails
- Schools
- Clinics
- High water table areas

CAPACITY

Recommended users per day.

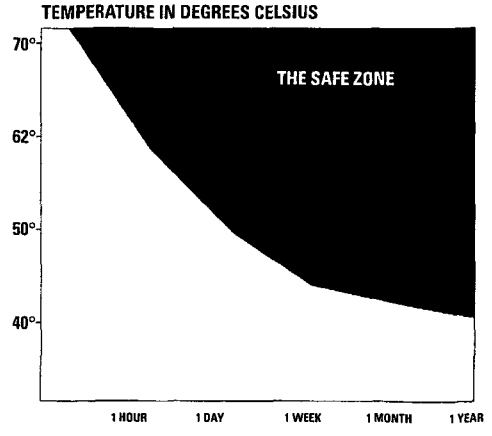
- Domestic Model: 8 to 12 people per day

THE COMPOSTING PROCESS

- Just as Nature recycles garden refuse into compost, the Enviro Loo composting toilet provides the right environment allowing human waste, toilet paper and organic material to break down through the natural composting process into an inoffensive compost like material. Oxygen, moisture, heat and organic material are required for the aerobic bacteria and microbes to recycle human waste into a good fertilising material.
- Radiant heat is absorbed and conducted through the U.V. protected black polyethylene plastic of the manhole cover and vent pipe.
- Through the designed ventilation system, adequate oxygen is provided for the aerobic decomposition and deodorising process.
- Human faeces consists of roughly 95% liquid. As the solids dry on the grid the liquid portion drains to the bottom of the container / pit, which via the ventilation through the system is evaporated and vented to atmosphere. The solid waste then dries and decomposes into a compost like material, roughly 5 to 10% of its original mass.

ODOUR FREE

The designed ventilation system aided by the high internal temperature causes a negative pressure within the container which ensures no backdraft into the toilet pan. The airflow is assisted by the patented aerobic toilet ventilation extraction unit, positioned on the top of the outlet vent pipe. Air is drawn into the container via the inlet vent pipes. The operation of the aerator above the grid and the adequate ventilation ensures fast odourless decomposition of human waste.



PATHOGEN ELIMINATION BY HEAT

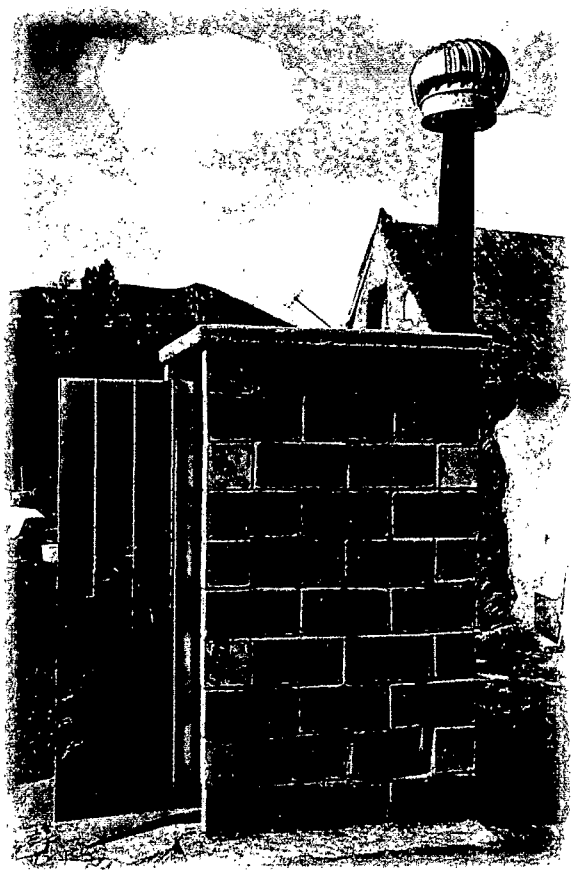
Reference: ***Dr Homero Silva Serrano***
University of Costa Rica
Report on Sanres Workshop II 1994

VENTILATION

- Under normal working conditions the radiant heat conducted through the external black plastic cover provides temperatures of up to 55 degrees celsius within the container, providing a positive updraught into the outlet vent pipe.
- The airflow is further assisted by the non-electric ventilation extraction unit.
- Measured wind speeds of as low as 4 km/h provides an airflow of 100 cubic metres per hour through the system. Under these conditions approximately two kilograms of liquid can be evaporated on a daily basis, through the outlet vent pipe.

MAINTENANCE

- Enviro Loo toilets require minimal regular maintenance. It is recommended that a handful of the prepared organic additive is added into the toilet through the toilet bowl after use.
- The waste on the grid needs to be mixed and aerated on a daily basis, this is simply operated through the handle on the toilet backrest.
- The Enviro Loo requires NO servicing for the first eighteen months to two years after installation. Thereafter only the dried matter is removed on an annual basis depending on the number of users per day. Under lower usage conditions the maintenance required can extend to every two to three years. The dried matter is simply raked from the drying plates into the collection box and removed through the manhole.
- The dried waste matter can be further treated via forced aeration composting mixed with other organic waste material and used for soil fertilisation.



SPECIFICATIONS

	Container	*Brick Pit*
Dimensions of unit:		
Length:	1 800mm	1 800mm
Width:	600mm	800mm
Depth:	1 300mm	1 700mm
Dimensions of pit required for installation		
Length:	2 000mm	2 300mm
Width:	1 000mm	1 300mm
Depth:	1 400mm	1 850mm
Weight per unit:	85kg	35kg

- The units have been designed for the seperate components to stack allowing for compact and economical transport and shipping.
- Ceramic toilet bowl supplied per unit.
- Do it yourself assembly and installation on site. An assembly, installation and operational manual is provided.

ENVIRO OPTIONS

ENVIRO OPTIONS (PTY) LTD
P. O. Box 71782, Bryanston 2021
Tel: 27 11 708 2245 *Fax:* 27 11 708 2180
PAT NO: 94/2598; 95/6540; 97/4355; AP/P/00690
PAT PENDING:96/5669 ENVIROLOO: ®

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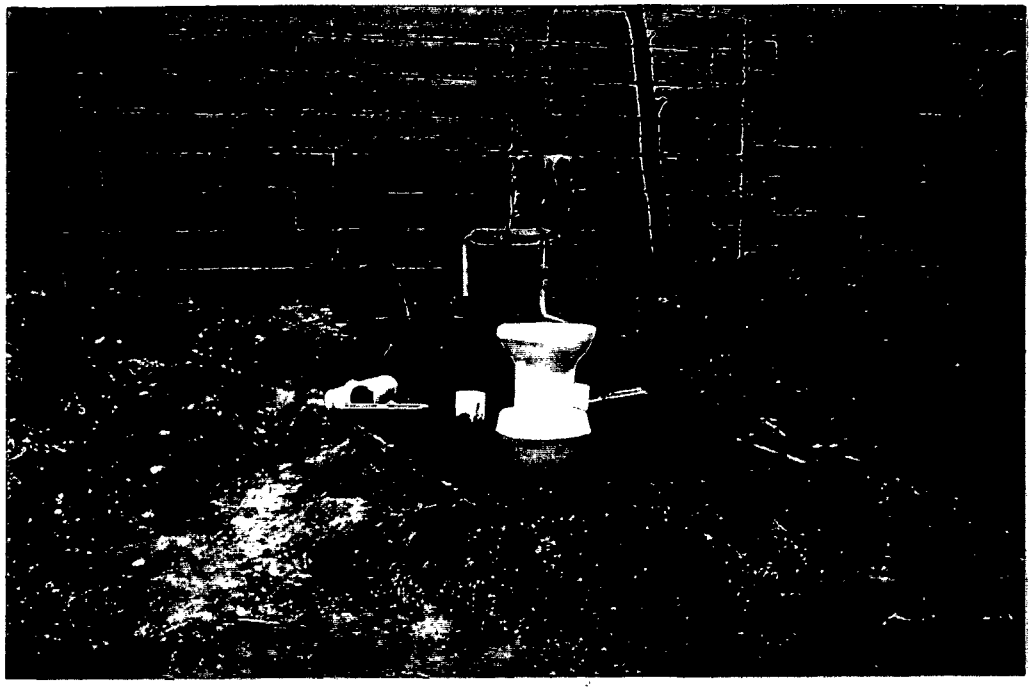
APPENDIX B

PHOTOGRAPHS OF INSTALLATION OF ENVIRO LOO LATRINES AND CONSTRUCTION OF SUPERSTRUCTURES

Photograph A :

Installation of Enviro Loo latrine in the ground prior to casting of floor slab

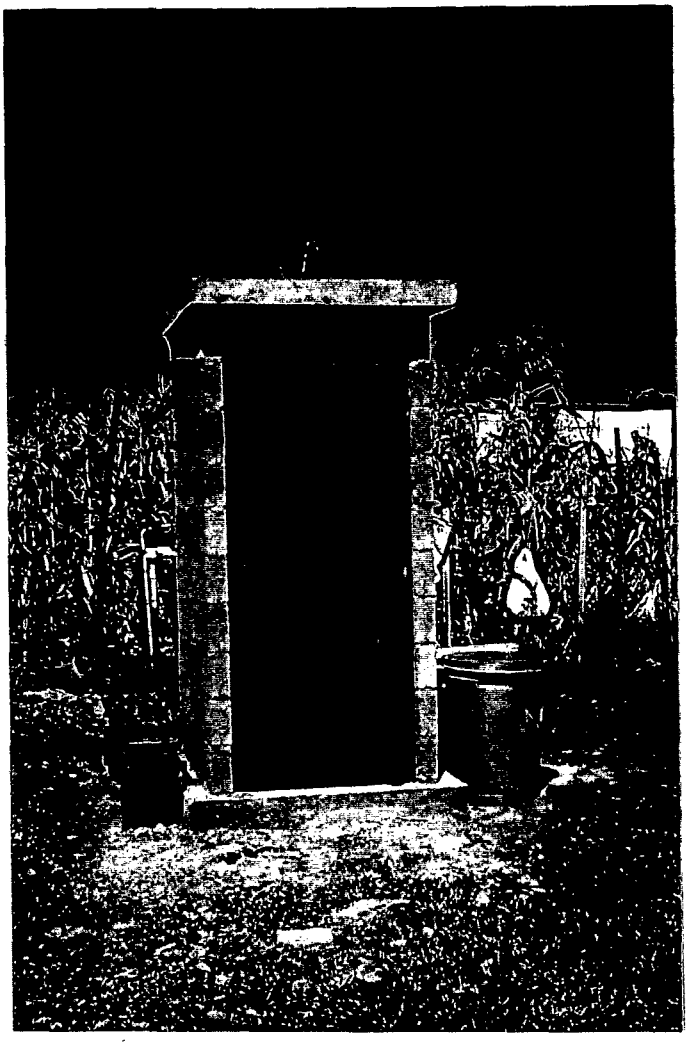
Photograph B : Casting of concrete floor slab



Photograph C : Freshly cast floor slab with toilet bowl in place

Photograph D : Construction of the walls of the superstructure

Photograph E : Installation of latrine door prior to positioning of roof slab



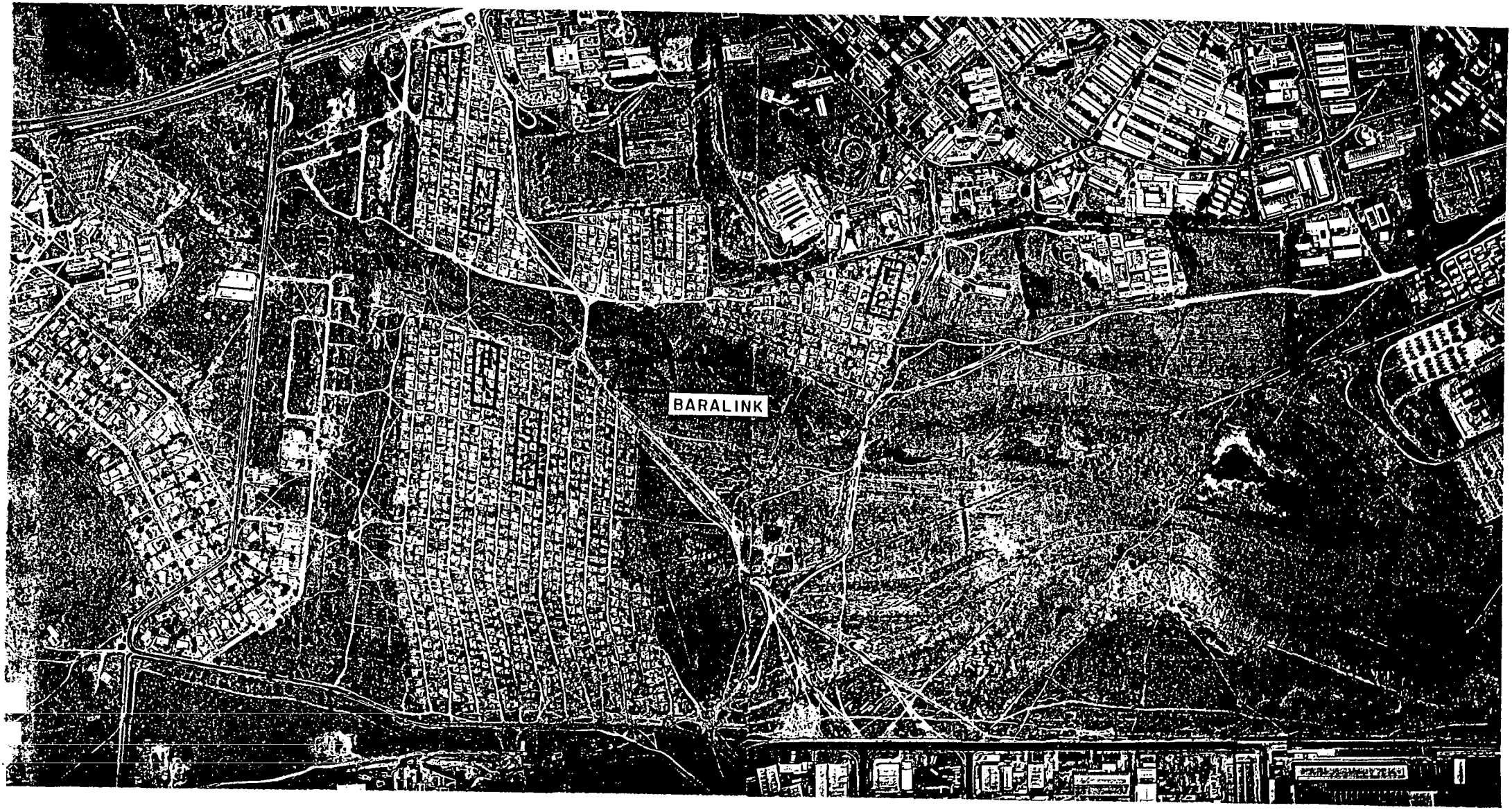
Photograph F : Completed superstructure prior to finishing

Photograph G : Final finishing of installed Enviro Loo latrine

Photograph H : User education meeting for the Enviro Loo users in Elias Motsoaledi community hall at the commencement of the project

APPENDIX C

LOCATION OF HOUSEHOLDS IN THE INFORMAL SETTLEMENT INVOLVED IN THE RESEARCH PROJECT

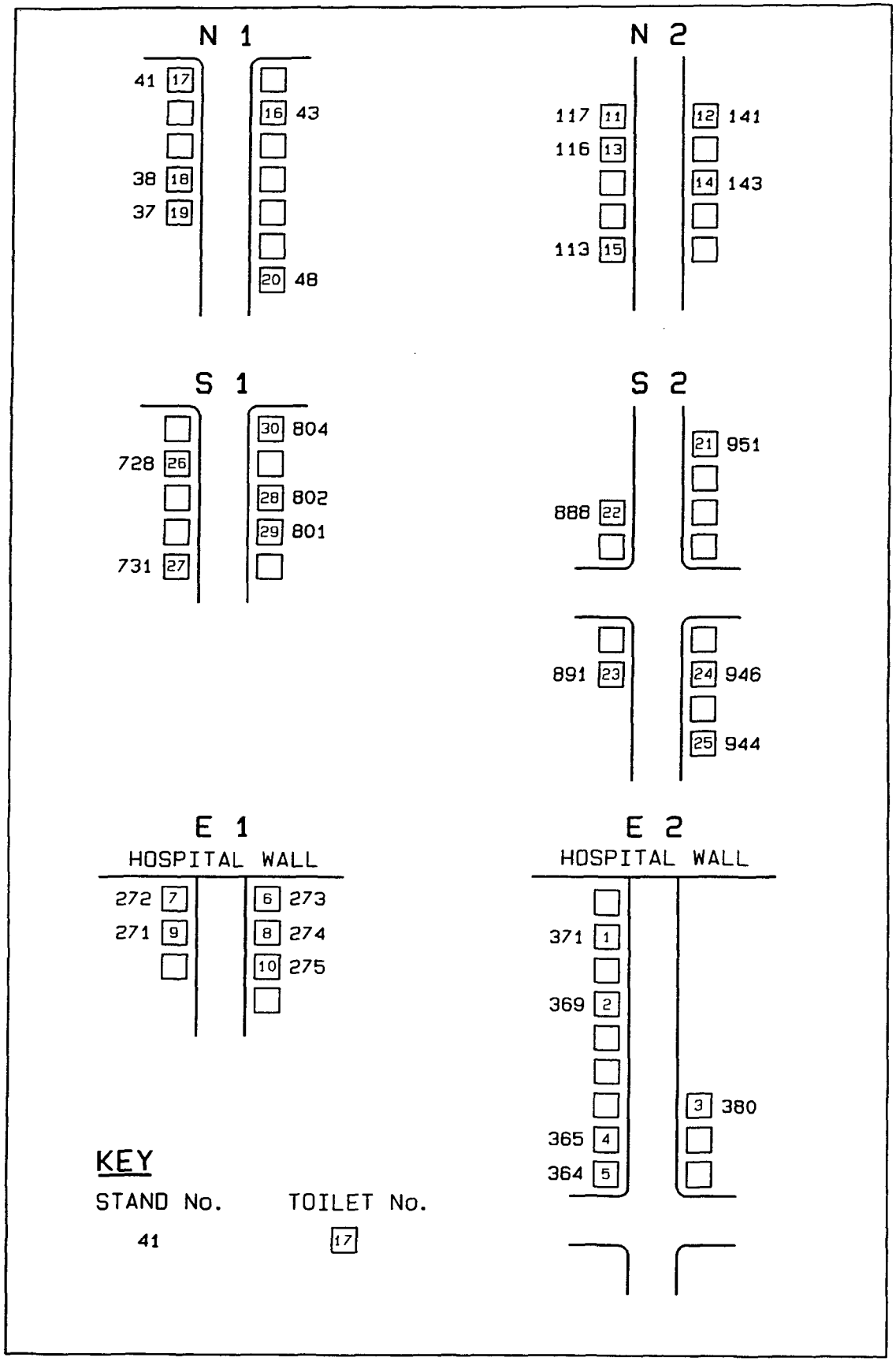


AERIAL PHOTOGRAPH OF BARALINK (JANUARY, 1996)
SHOWING HOUSING BLOCKS SELECTED FOR THE STUDY

BARALINK - COMPOSTING TOILET PROJECT

Toilet numbers, stand numbers and number of household residents for the composting toilet users (study group) and chemical toilet users (control group) are given below. Baralink is divided into three areas ie. North, South and East. There are two groups of five composting toilet users/non-users for each area. Stand numbers were changed in June 1996. This is the revised list.

Study Group				Control Group			Area
Toilet number	Stand number		Residents	Stand number		Residents	
	Old	New		Old	New		
1	1207	371	2	1206	370	5	East (E2)
2	1205	369	5	1088	379	4	
3	1215	380	5	1214	372	2	
4	1202	365	2	1203	397	7	
5	1201	364	2	1217	382	3	
6	1041	273	6	1046	280	2	East (E1)
7	1044	272	2	1037	281	5	
8	1043	274	3	1048	270	6	
9	1042	271	2	1039	276	2	
10	1045	275	4	1050	139	10	
11	276	117	2	274	119	5	North (N2)
12	469	141	5	471	140	6	
13	278	116	4	280	115	3	
14	465	143	6	463	144	3	
15	284	113	3	286	112	1	
16	243	43	2	245	42	3	North (N1)
17	2	41	4	1	6	3	
18	8	38	3	7	4	5	
19	10	37	5	9	40	6	
20	233	48	10	231	49	1	
21	634	951	3	633	887	12	South (S2)
22	631	888	5	629	954	4	
23	625	891	7	627	890	4	
24	624	946	5	626	947	6	
25	620	944	10	618	943	5	
26	449	728	5	451	805	3	South (S1)
27	448	731	3	501	727	3	
28	444	802	3	446	803	1	
29	442	801	6	440	800	5	
30	443	804	2	445	730	5	



Schematic layout and location of stands on which Enviro Loo latrines are located

APPENDIX D

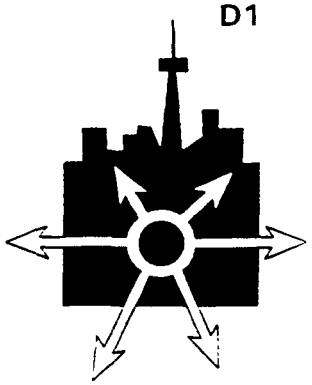
BACKGROUND AND ROUTINE MONITORING QUESTIONNAIRE

(The results and full data set obtained from the questionnaire are held by the Epidemiology and Health Information Systems Sub-Cluster, Greater Johannesburg Metropolitan Council)

GREATER JOHANNESBURG
TRANSITIONAL METROPOLITAN COUNCIL

Johannesburg Administration
Health, Housing and Urbanisation

D1



Metropolitan Centre
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EVALUATION OF THE HEALTH IMPACT AND OTHER ASPECTS OF THE COMPOSTING LATRINES ON THE COMMUNITY IN AN INFORMAL SETTLEMENT AT BARALINK IN GREATER JOHANNESBURG

This questionnaire is to be administered by a trained person to the household members at Baralink using Composting latrines (Study group) and those who are not using them, (Control group) in order to measure their knowledge, attitudes and practice regarding sanitation facilities.

Instructions: *Circle the correct answer*

Background information :

Name of Interviewer ..... Respondent .....

Date ..... Time .....

1. a) Which group? Study /Control

   b) Stand number ..... Toilet number *(Study group only)* .....

2. Predominant Home Language ....

3. Composition of household ? (*excluding visitors*)

	Male	Female
Children below 5 yrs		
5 - 18 yrs.		
Adults 18 & above		
Total		

4. a) What does the head of this household do for a living ?

i) Formally employed YES / NO

ii) Self employed ? YES / NO

iii) Part- time worker YES / NO

iv) Home duties YES / NO

v) Pensioner YES / NO

vi) Unemployed YES / NO

b) If yes to (i), ii), iii) what is his or her occupation .....

5. What is the average monthly income of the household ? R .....

6. Which chronic medical conditions do members of this household suffer from ?
(state age and number of members suffering from each condition)

a) Hypertension ..... yrs. .....

b) CVA (stroke) ..... yrs. .....

c) Asthma ..... yrs. .....

d) Diabetes Mellitus ..... yrs. .....

e) Ulcers (gastric) ..... yrs. .....

f) TB ..... yrs .....

g) Other (specify) .... yrs .....

7. a) Is there a disabled person in your family ? YES / NO

b) If yes to a) , describe the disability .....

c) If yes to a) above which toilet is used *(Interviewer to probe the reasons why)*

.....

.....

8. a) What is the source of the water you use?

Tap	Tank	Stream	Borehole	Other (specify)

.....

b) How far away is this source? .....metres
(Responsibility of the interviewer to estimate the distance)

9. Please answer the following questions about your toilet ?

a) Does it need water to flush YES / NO

b) Does the toilet need to be emptied YES / NO

c) If yes, for b) state :

(i) How often should it be emptied .....

d) * **For composting toilet users only :**

(i) What happens to the urine / faecal matter inside the toilet?

.....

ii) What is the purpose of the handle ? .....

.....

iii) What is the purpose of the organic mix (compost) .....

.....

iv) What is the purpose of the toilet powder .....

.....

10. a) How do you feel about the safety of the toilet you use ?

Very safe	Safe	Not safe	Don't know

b) If you feel the toilet is not safe , explain ?

.....

.....

11. Which sanitation facility do you use at night ?

Composting toilet	Chemical toilet	Potty or Bucket	Other (specify)

12. If your answer to qes 11. is a *potty/bucket* or *other* where do you throw the waste water in the morning ?

Composting toilet	Chemical toilet	Yard	Veld

TMC TECHNICAL / HEALTH QUESTIONNAIRE

13. Which cleansing material do you use ?

    a) Toilet paper YES / NO

    b) Newspaper YES / NO

    c) Both toilet paper and newspaper YES / NO

    d) Other (specify) .....

    * **Questions 14, 15,&16 For composting toilet users only.**

14. a) How often do you clean the toilet ? .....

    b) What do you use to clean your toilet ? .....

    c) Who normally cleans the toilet? .....

15. When last did you add organic mix into your toilet ? ...../...../.....

16. When last did you use the powder provided ? ...../...../.....

17. Did any of the members of your household have any ***diarrhoeal episode / loose stools*** in the past 2 weeks ? (*Diarrhoea : 3 or more loose stools in 24 hrs.*)
    YES / NO

18. If yes, for 17. answer the following questions :

Age of affected person			
Gender			
Form of Treatment			
None			
Self administered			
Mobile clinic			
Koos Beukes			
Hospital			
Private Doctor			
Traditional Healer			

19. Did any of your household members suffer from any ***upper respiratory ailments*** in the past 2 weeks ? (*Upper resp. ailments :- flu, running nose, coughing.*)

YES / NO

20. If yes, for ques. 19 answer the following questions :

Age of affected person *(yrs)*			
Gender *(M/F)*			
Form of Treatment *(tick answer below)*			
None			
Self administered			
Mobile clinic			
Koos Beukes			
Hospital			
Private Doctor			
Traditional Healer			

21. Do you experience any of the following problems with respect to your toilet ?

a) Flies YES / NO

b) odour / smell YES / NO

c) other (specify) .....

.....

22. If yes, to any of the above, state the following :

Weather conditions -

a) Cloudy YES / NO

b) Sunny YES / NO

c) Windy YES / NO

d) other (specify) .....

Time of the day :

i) Morning YES / NO

ii) Afternoon YES / NO

iii) During the night YES / NO

iv) During the day YES / NO

23. a) Have you encountered any problems with the toilet you are using ? YES / NO

b) If yes, to 23 a) state problems .....

.....

General remarks by the interviewer (including improvement made on the toilet)

.....

.....

Observations by Research Monitors

24. Observation in Cubicle

a) Cleansing material (for personal hygiene) present on the rails, etc.

i) Toilet paper YES / NO

ii) Newspaper YES / NO

iii) Plastic YES / NO

iv) Other (specify) .....

b) Cleanliness inside the cubicle (faecal , cleansing material or other dirt) :

i) Is the floor CLEAN / DIRTY

ii) Is the toilet seat CLEAN / DIRTY

iii) Is the toilet Shute (bowl) CLEAN / DIRTY

c) Malodours :

i) Is there a foul smell inside the cubicle ? YES / NO

ii) How bad is it ? VERY BAD / BAD / NOT BAD

d) Are there flies in the cubicle ? YES / NO

e) Is there solid waste in the chute (bowl) ? YES / NO

f) Miscellaneous :

i) Is the toilet lid OPEN / CLOSED

ii) Is the toilet door OPEN / CLOSED

APPENDIX E

SUMMARISED RESULTS FROM THE BACKGROUND QUESTIONNAIRE

BASELINE HOUSEHOLD CHARACTERISTICS OF THE STUDY AND CONTROL GROUPS

Characteristic/Measurement	May 1996		November 1996	
	Control group	Study group	Control group	Study group
Number of Households	30	30	30	30
Respondents	29	30	28	30
Total Number of People	105	117	108	128
Average per Household	3.5	3.9	3.9	4.3
Age Distribution <5	17	7	16	13
5 - 18	32	38	38	38
>18	56	72	54	77
Gender Distribution Male	60	58	55	61
Female	45	59	53	67
Employment Status (Heads of Households)				
Unemployed	30	6.7	7.7	6.9
Employed	66.7	90	84.6	90
Pensioner	3.3	3.3	7.7	3.4
Average Income	R908	R915	R975	R1020
Predominate Language Spoken (% of Households)				
Xhosa	63.3	33.3	67.86	40
Zulu	20	26.7	14.3	36.7
Tsonga [*Sotho]	6.7	6.7	10.7	6.7*
Prevalence of Chronic Diseases (% of people)				
Asthma	3.2	0	1.9	1.6
High Blood Pressure	2.1	2.6	1.9	1.6
Ulcers	1.05	1.7	0	0.8
TB	0	0	0	0.8
Diabetes	1	0	0.9	0
Overall Prevalence of Chronic Diseases	6.7	4.3	4.6	5.5
Age Distribution of Chronic Diseases 5-18 yrs	1	0	1	2
>18	6	5	4	5

Characteristic/Measurement	May 1996		November 1996	
	Control group	Study group	Control group	Study group
Opinion on Safety of Toilets (% of respondents)				
Very Safe	13.8	75	7.7	34.5
Safe	17.2	21.4	11.5	55.2
Not safe	69	3.6	80.8	10.3
Facility Used at Night (% of respondents)				
Potty	55.1	71.4	69.2	75.9
Chemical Toilet	44.8	N/A	30.8	N/A
Composting Toilet	N/A	28.6	N/A	24.1
Disposal of Wastewater from Potty (% of respondents)				
Chemical Toilet	81	23.8	100	36.4
Composting Toilet	N/A	28.6	0	18.2
Yard	19	47.6	0	45.5
Water Source Mean Distance (metres)	74.5	75.7	122	112
Knowledge of How the Toilets Function (% score)				
General Knowledge	93.1	63.3	85.9	58.8
Specific Knowledge	N/A	76.9	N\A	60.8
Most frequent employment cited *(% of employed)*				
General Worker	54.5	45.8	54.5	45.8
Security Guards	4.5	8.3	4.5	8.3
Drivers	9.1	16.7	9.1	16.7
Other	31.8	29.2	31.8	29.2

APPENDIX F

FIELD OBSERVATIONS OF THE ENVIRO LOO LATRINES MADE DURING THE COURSE OF THE PROJECT

(Including ambient air temperature measurements recorded inside the latrine containers and relevant meteorological data)

AREA	DATE: 18th May 1996					WEATHER CONDITIONS: Rain day before, still, partly cloudy/sunny & slight breeze after 11h00	
	STAND NO	TOILET NO	ASPECT	AIR TEMP °C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	12,2	09.30	Y	
	802	28	NORTH	12,7	09.35	Y	
	801	29	EAST	12,4	09.40	Y	
	728	26	WEST	12,7	09.50	Y	
	731	27	WEST	12,7	09.55	N	
	951	21	SOUTH	15,6	12.10	Y	
	888	22	SOUTH	15,6	12.15	Y	
	891	23	SOUTH	15,1	12.20	Y	
	944	25	SOUTH	15,0	12.25	Y	
	946	24	EAST	14,2	12.30	Y	
EAST	273	6	NORTH	12,7	10.45	Y	Toilet near to wall
	274	8	NORTH	13,3	10.45	Y	
	271	9	NORTH	15,9	12.10	Y	
	272	7	NORTH	13,1	10.40	Y	Toilet near to wall
	275	10	NORTH	13,5	10.50	Y	Slight odour present, a few flies observed
	371	1	SOUTH	13,6	10.20	Y	
	369	2	NORTH	12,3	10.10	N	Slight odour present
	364	5	NORTH	12,2	10.15	Y (Just)	
	365	4	EAST	12,9	10.15	Y (Just)	
	380	3	EAST	13,0	10.15	Y	
NORTH	113	15	SOUTH	13,9	11.00	Y	A few flies observed
	143	14	SOUTH	14,2	11.05	Y	
	116	13	WEST	14,0	11.10	Y	A few flies observed
	141	12	WEST	14,5	11.20	Y	
	117	11	SOUTH	14,6	11.20	Y	
	43	16	EAST	14,8	11.45	Y	
	41	17	WEST	15,4	11.50	Y	
	38	18	WEST	15,0	11.40	Y	
	37	19	WEST	15,0	11.35	Y	
	48	20	EAST	14,5	11.30	Y	

AREA	DATE: 22nd June 1996					WEATHER CONDITIONS:Cold, partly cloudly and breezy. More cloud, less sun by mid-morning.	
	STAND NO	TOILET NO	ASPECT	AIR TEMP °C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	9,7	09.30	Y	
	802	28	NORTH	10,2	09.25	Y	
	801	29	EAST	10,4	09.35	Y	
	728	26	WEST	9,2	09.20	Y	
	731	27	WEST	9,7	09.40	Y	
	951	21	SOUTH	9,9	09.45	Y	
	888	22	SOUTH	9,8	09.45	Y	
	891	23	SOUTH	9,7	09.50	Y	
	944	25	SOUTH	9,9	10.05	Y	Slight smell discernible; users say toilet handle not working
	946	24	EAST	11,5	10.00	Y	Slight smell discernible; users say toilet handle not working
EAST	273	6	NORTH	8,6	10.25	Y	
	274	8	NORTH	10,1	10.30	Y	
	271	9	NORTH	-	-	Y	No one at home; gates locked; manhole cover not opened
	272	7	NORTH	8,3	10.20	Y	
	275	10	NORTH	10,6	10.35	Y	
	371	1	SOUTH	10,4	10.55	Y	
	369	2	NORTH	10,4	10.50	Y	
	364	5	NORTH	10,6	10.40	Y	
	365	4	EAST	10,6	10.45	Y	Toilet door painted
	380	3	EAST	9,9	10.50	Y	Toilet door painted
NORTH	113	15	SOUTH	9,9	11.10	Y	
	143	14	SOUTH	11,1	11.15	Y	Step and little wall constructed to divert stormwater from entering toilet
	116	13	WEST	10,9	11.20	Y	
	141	12	WEST	10,8	11.30	Y	
	117	11	SOUTH	11,2	11.25	Y	
	43	16	EAST	11,3	11.45	Y	Step constructed in front of toilet
	41	17	WEST	11,7	11.45	Y	User complains of smell and flies - no better than chemical toilet
	38	18	WEST	10,8	11.40	Y	
	37	19	WEST	11,5	11.40	Y	
	48	20	EAST	12,2	11.35	Y	

AREA	DATE: 31st August 1996					WEATHER CONDITIONS:Cloudless, sunny and quite warm; very slight breeze	
	STAND NO	TOILET NO	ASPECT	AIR TEMP °C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	15,4	13.00	Y	
	802	28	NORTH	18,2	12.55	Y	
	801	29	EAST	18,8	12.50	Y	
	728	26	WEST	17,3	13.00	Y	
	731	27	WEST	17,5	12.50	Y	
	951	21	SOUTH	16,7	12.45	Y	
	888	22	SOUTH	17,1	12.40	Y	
	891	23	SOUTH	17,3	12.30	Y	
	944	25	SOUTH	17,4	12.25	Y	Some liquid on container floor
	946	24	EAST	18,4	12.35	Y	
EAST	273	6	NORTH	13,4	11.40	Y	Toilet close to wall - in shadow
	274	8	NORTH	16,7	11.40	Y	
	271	9	NORTH	17,8	11.50	Y	
	272	7	NORTH	13,9	11.45	Y	
	275	10	NORTH	17,3	11.35	Y	
	371	1	SOUTH	-	-	Y	No one at home; gates locked; manhole cover not opened
	369	2	NORTH	16,7	12.05	Y	
	364	5	NORTH	18,6	12.15	Y	
	365	4	EAST	17,1	12.15	Y	Flies present around toilet
	380	3	EAST	16,8	12.10	Y	
NORTH	113	15	SOUTH	15,8	11.25	Y	
	143	14	SOUTH	15,4	11.20	Y	
	116	13	WEST	15,9	11.20	Y	
	141	12	WEST	15,4	11.10	Y	
	117	11	SOUTH	15,5	11.15	Y	
	43	16	EAST	15,9	10.45	Y	
	41	17	WEST	15,9	10.35	Y	
	38	18	WEST	14,8	10.55	Y	
	37	19	WEST	15,7	11.00	Y	Flies present around toilet
	48	20	EAST	15,9	11.05	Y	Users say windmaster does not always turn; flies present around toilet

AREA	DATE: 25 October 1996					WEATHER CONDITIONS: Some clouds early on; then sunny with slight breeze	
	STAND NO	TOILET NO	ASPECT	AIR TEMP °C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	19,7	10.20	Y	A few flies present when manhole opened
	802	28	NORTH	20,9	10.25	Y	Flies present when manhole opened
	801	29	EAST	20,1	10.30	Y	A few flies present when manhole opened
	728	26	WEST	19,7	10.10	Y	A few flies present when manhold opened
	731	27	WEST	-	-	Y	}
	951	21	SOUTH	-	-	Y	}
	888	22	SOUTH	-	-	Y	}Unopened - power drill failure
	891	23	SOUTH	-	-	Y	}
	944	25	SOUTH	-	-	Y	}
	946	24	EAST	-	-	Y	}
EAST	273	6	NORTH	19,4	09.10	Y	Flies present
	274	8	NORTH	19,2	09.15	Y	
	271	9	NORTH	19,9	09.20	Y	
	272	7	NORTH	19,1	09.05	Y	Some flies present
	275	10	NORTH	19,6	09.20	Y	Flies present in container when manhole opened
	371	1	SOUTH	17,8	08.35	Y	Flies present
	369	2	NORTH	18,9	08.40	Y	A few flies present
	364	5	NORTH	18,6	09.00	Y	A few flies present
	365	4	EAST	18,4	08.55	Y	A few flies present
	380	3	EAST	18,2	08.50	Y	A few flies present
NORTH	113	15	SOUTH	18,6	09.30	Y	A few flies present
	143	14	SOUTH	18,7	09.35	Y	A few flies present - owner says flies and smell present when windmaster does not turn
	116	13	WEST	19,3	09.40	Y	Some flies present in container when manhole opened
	141	12	WEST	19,7	09.45	Y	A few flies present
	117	11	SOUTH	19,0	09.45	Y	A few flies present when manhole opened. Faint odour detectable
	43	16	EAST	19,5	10.00	Y	
	41	17	WEST	20,3	09.55	Y	
	38	18	WEST	-	-	Y	Unopened - power drill failure
	37	19	WEST	20,1	09.55	Y	A lot of flies present when manhole opened
	48	20	EAST	-	-	Y	Unopened - power drill failure

EA130066

BARALINK COMPOSTING TOILETS:
OBSERVATIONS MADE DURING RETROFITTING OF AGITATOR ROD

Date: 18/11/96 (AM)
Weather: Sunny, but partly cloudy; breezy; cool after weekend rain

Area: South 1
Stand No: 804; Toilet No: 30
Photo No: -

Cobwebs inside container when opened. Toilet paper and newspaper visible, but no rubbish. Waste on top grid and starting to fall to second grid. Liquid on floor of container, but underneath bottom plate. Faecal matter appears fairly moist. A few flies around and faint odour present Integrity of toilet good - slight inward bulge on rear of container. Door creaks and door pole a bit bent. Inside of toilet clean. Small piece of carpet on which to place feet. Organic cleaner and toilet paper present Windmaster turning OK.

Area: South 1
Stand No: 728; Toilet No: 26
Photo No: -

Toilet paper and matchbox visible inside container. Waste on top grid only. Liquid on floor of container, but beneath bottom plate. Faecal matter appears moist. Some flies around and faint odour present. Integrity of toilet good - slight inward bulge on rear of container. Windmaster turning OK.

Area: South 1
Stand No: 802: Toilet No: 28
Photo No: -

Toilet paper and newspaper visible inside container. Waste on top grid only. Small amount of liquid on floor of container beneath bottom plate. Slight odour present. Integrity of toilet good. Small mat on floor for feet. Sign on back of door. Windmaster turning OK.

Area: South 1
Stand No: 801; Toilet No: 29
Photo No: -

Toilet paper visible inside container with some fallen on to bottom plate. Waste on top grid only and plenty of compost present. Liquid on floor of container but beneath bottom plate. A few flies around. Inside of toilet a bit dirty with skid marks on toilet bowl chute. However, toilet door has been painted, floor tiled with a carpet for the feet. Toilet paper, compost and organic cleaner present. Sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: South 1
Stand No: 731: Toilet No: 27
Photo No: -

Toilet does not look heavily used. Waste not piled very high on upper grid. Toilet paper and a piece of plastic visible inside container. Only a little liquid on floor of container beneath bottom plate. A few flies around. Toilet bowl chute a little dirty, but floor tiled. Organic cleaner and toilet brush present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Date: 20/11/96 (AM)
Weather: Sunny with breeze and clouds coming in from NW

Area: South 2
Stand No: 951; Toilet No: 21
Photo No: 1

Toilet paper only visible in the container. Waste material starting to fall through holes of upper grid. Some liquid on floor of container beneath bottom plate. A few flies around. Toilet bowl chute has skid marks. Organic cleaner, toilet brush and compost present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: South 2
Stand No: 888; Toilet No: 22
Photo No: 2

Toilet paper and newspaper visible in container. Waste material starting to fall from upper to second grid. Some liquid on floor of container beneath bottom plate. Flies around. Toilet clean with toilet paper, organic cleaner, toilet brush and compost present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: South 2
Stand No: 891; Toilet No: 23
Photo No: 3

Toilet paper and newspaper visible in container, which is half full of liquid due to incorrect use (disposal of grey water). Toilet itself clean with toilet paper and brush present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: South 2
Stand No: 946; Toilet No: 24
Photo No: 4

Toilet paper and newspaper visible in container. Toilet not heavily used - waste material small and no liquid on floor of container. Toilet bowl chute has skid marks, but organic cleaner and toilet brush present. Integrity of toilet good. Windmaster turning OK.

Area: South 2
Stand No: 944; Toilet No: 25
Photo No: 5

Toilet paper and newspaper present in container. Compost visible in waste material. Some liquid in floor of container which is above the bottom grid. No worms observed in waste material (previously seen by G La Trobe). The owner (the sangoma) claims stormwater is the cause, but could be residue of previous occasion when the pump out was required. Ground has sagged a little around container which could encourage water ingress. Toilet clean with organic cleaner and toilet brush present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Date: 21/11/96 (AM)
Weather: Cloudy, breezy with rain pending

Area: North 1
Stand No: 41; Toilet No: 17
Photo No: 6

Toilet paper only visible in container. Not well used. Small amount of waste material and slight trace of liquid on floor of container. Integrity of toilet good, though some inward collapse of container on left side. Windmaster turning OK.

Area: North 1
Stand No: 43; Toilet No: 16
Photo No: 7

Toilet paper only visible in container. Not heavily used. Faecal matter appears quite dry. Small amount of liquid on floor of container. Step outside toilet with mat and carpet tiles inside. Toilet paper, organic cleaner and toilet brush present and sign on back of door.

Area: North 1
Stand No: 38; Toilet No: 18
Photo No: 8

Toilet paper only visible in container. Waste material starting to fall from upper grid to second grid. Faecal matter appears moist. Some liquid on floor of container beneath bottom plate. Mat present outside toilet door. Organic cleaner, toilet brush and compost present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: North 1
Stand No: 37; Toilet No: 19
Photo No: 9

Toilet paper and roll visible in container. Waste material starting to fall from upper grid to second grid. A little liquid on floor of container beneath bottom plate. Toilet door squeaks, but carpet on floor. Toilet paper, organic cleaner, scrubbing and toilet brush present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: North 1
Stand No: 48; Toilet No: 20
Photo No: 10

Toilet paper and newspaper visible in container. Waste material on upper grid only and small amount of liquid on floor of container beneath the bottom plate. A few flies around. Organic cleaner and toilet brush present. Stormwater entering cubicle beneath door. Otherwise, integrity of toilet good. Windmaster turning OK.

Area: North 2
Stand No: 117; Toilet No: 11
Photo No: 11

Toilet paper only visible in container. Waste material on upper grid only. Liberal use of compost evident in waste material - gives a drier appearance to faecal matter. Some liquid on floor of container beneath bottom plate. A few flies around. Toilet clean inside with organic cleaner, toilet brush and compost present. Sign on back of door, but peeling off. Integrity of toilet good. Windmaster turning OK.

Area: North 2
Stand No: 141; Toilet No: 12
Photo No: 12

Toilet paper only visible in container. Waste material starting to fall from upper to second grid. Faecal matter appears moist. A little liquid on floor of container beneath bottom plate. A few flies around. Toilet very clean. Floor painted. Toilet paper, organic cleaner and toilet brush present. Integrity of toilet good. Windmaster turning OK.

Area: North 2
Stand No: 116; Toilet No: 13
Photo No: 13

Mainly newspaper visible in container. Waste material starting to fall from upper to second grid. Faecal matter appears quite moist. Some liquid on floor of container beneath bottom plate. Flies present. Compost bag stacked behind container. Organic cleaner and toilet brush present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: North 2
Stand No: 143; Toilet No: 14
Photo No: 14

Toilet paper and newspaper visible in container as well as a piece of plastic. Waste material starting to fall from upper to second grid. Faecal matter appears moist. Some liquid on floor of container beneath bottom plate. Slight odour present and a few flies around. Small wall and step constructed to divert stormwater away from toilet, but stormwater still evidently entering cubicle from previous day's rain. Mat on floor. Some skid marks on toilet bowl chute, but organic cleaner and toilet brush present. Two signs on back of door. Integrity of toilet fair, though some collapse of container on right side. Windmaster turning OK.

Area: North 2
Stand No: 113; Toilet No: 15
Photo No: 15

Toilet paper and newspaper visible in container. Waste material starting to fall from upper to second grid. Faecal matter quite moist, but only a little liquid on floor of container beneath bottom plate. One or two flies present. Integrity of toilet fair, though with some inward bulging of container on both sides. Windmaster turning OK.

Date: 22/11/96 (AM)
Weather: Sunny and partly cloudy

Area: East 1
Stand No: 273; Toilet No: 6
Photo No: 16

Toilet paper only visible in container. Waste material starting to fall from upper to second grid and compost liberally applied. No liquid on floor of container. Toilet very clean. Toilet paper, organic cleaner and toilet brush present. Sign on back of door. Some bulging of container sides, otherwise integrity of toilet good. Windmaster turning OK.

Area: East 1
Stand No: 272; Toilet No: 7
Photo No: 17

Toilet paper only visible in container. Waste material confined still to upper grid and compost liberally applied. A little liquid on floor of container beneath bottom plate. Toilet very clean. Floor has been tiled and toilet paper and brush present. Sign on back of door. Manhole cover does not fit very well, otherwise integrity of toilet good. Windmaster turning OK.

Area: East 1
Stand No: 274; Toilet No: 8
Photo No: 18

Toilet paper only visible in container. Waste material still confined to upper grid and compost evident in faecal matter. Just a small amount of liquid on floor of container. A few flies around. Toilet very clean. Toilet paper and brush present. Sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: East 1
Stand No: 271; Toilet No: 9
Photo No: 19

A lot of toilet paper visible in container. Waste material only on upper grid and no liquid on floor of container. Step outside of toilet and floor tiled. Lower vent pipes have plastic bags in them and gauze on the outside. Integrity of toilet good. Windmaster turning OK.

Area: East 1
Stand No: 275; Toilet No: 10
Photo No: 20

Toilet paper only visible in container. Waste material starting to fall from upper to second grid and a lot of compost evident in faecal matter. Virtually no liquid on floor of container. Slight odour present. Step installed to toilet and linoleum on floor. Organic cleaner, toilet brush and compost present and sign on back of door. Telephone directory in cubicle may be source of cleansing material. Integrity of toilet good. Windmaster turning OK.

Area: East 2
Stand No: 371; Toilet No: 1
Photo No: 21

Toilet paper only visible in container. Waste material confined to upper grid. Small amount of liquid on floor of container. A few flies around. Organic cleaner, toilet brush and compost present and sign on back of door. Bottom right hand screw to manhole covered with earth, otherwise integrity of toilet good. Windmaster turning OK.

Area: East 2
Stand No: 369; Toilet No: 2
Photo No: 22

Only toilet paper and a toilet roll visible in container. Waste material confined to upper grid and virtually no liquid on container floor. Mat on floor of toilet. Organic cleaner, Harpic container, toilet brush, compost and bucket present and sign on back of door. Integrity of toilet good. Windmaster turning OK.

Area: East 2
Stand No: 380; Toilet No: 3
Photo No: 23

Toilet paper only visible in container. Waste material starting to fall from upper to second grid and worms present in faecal matter. Very little liquid on floor of container. One or two flies around. Toilet door painted and floor is partly tiled and partly has linoleum. Toilet paper and organic cleaner present and sign on back of door. One screw missing from manhole cover, otherwise integrity of toilet good. Windmaster turning OK.

Area: East 2
Stand No: 365; Toilet No: 4
Photo No: 24

Toilet paper and newspaper present in container. Waste material confined to upper grid. No liquid on floor of container. A few flies around. Toilet clean and door painted. Mat on floor. Toilet paper and brush present and sign on back of door. Integrity of tpilet good. Windmaster turning OK.

Area: East 2
Stand No: 364; Toilet No: 5
Photo No: 25

Cobwebs in container when opened. Toilet paper and newspaper visible in container. Waste material still on upper grid. No liquid on floor of container. Toilet door noisy when opened, but toilet clean. Toilet paper present and some of the sign left on back of door. Integrity of toilet good. Windmaster turning OK.

AREA	DATE: 17 December 1996					WEATHER CONDITIONS: Warm, clear and sunny with a light breeze	
	STAND NO	TOILET NO	ASPECT	AIR TEMP °C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	23,4	11.00	Y	Very dry inside container; flap open; 1 or 2 flies present; toilet paper & cleaner present
	802	28	NORTH	23,1	11.05	Y	Flap open; no toilet paper, but brush & sign present
	801	29	EAST	23,6	11.15	Y	Flap open; toilet paper, cleaner, compost & sign present; door painted; floor tiled with mats
	728	26	WEST	22,1	11.30	Y	A few flies when container opened; flap open; toilet paper, cleaner, brush & sign present; linoleum on floor
	731	27	WEST	22,1	11.20	Y	A few flies when container opened; flap open; toilet paper, cleaner, brush & sign present
	951	21	SOUTH	22,3	10.40	Y	Toilet locked, 1 or 2 flies present when container opened; stormwater trench runs along back of toilet
	888	22	SOUTH	22,7	10.30	Y	A few flies when container opened; flap open; toilet paper, brush, compost, cleaner & sign present
	891	23	SOUTH	22,5	10.50	Y	2 screws to container missing; 1 or 2 flies present when container opened; flap open; no toilet paper, but cleaner, brush & sign present
	944	25	SOUTH	22,6	10.45	Y	Some build-up of soil on bottom right of container; a few flies when container opened. Flap open & not working; pan seat split; bucket & probe on hook on wall; sign on wall peeling off; no toilet paper but newspaper present.
	946	24	EAST	22,8	10.55	Y	Toilet locked; quite a few flies present when container opened
EAST	273	6	NORTH	24,1	12.20	Y	Subsidence of toilet slab noticeable; flap open; toilet paper, cleaner, brush & sign present
	274	8	NORTH	23,5	12.25	Y	Toilet locked
	271	9	NORTH	25,1	12.35	Y	Toilet locked

AREA	DATE: 17 December 1996					WEATHER CONDITIONS: Warm, clear and sunny with a light breeze	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	272	7	NORTH	24,3	12.15	Y	Flap open; toilet paper, brush & sign present
	275	10	NORTH	23,3	12.30	Y	Toilet locked; 1 or 2 flies when container opened
	371	1	SOUTH	24,0	11.45	Y	Build-up of soil on bottom right of container; door pole broken; flap open and not working; flies in container. No toilet paper but cleaner, brush, compost & sign present.
	369	2	NORTH	25,5	11.50	Y	Toilet locked
	364	5	NORTH	23,9	12.10	Y	Flap open; toilet paper & newspaper present
	365	4	EAST	23,7	12.00	Y	1 or 2 flies when container opened; flap open; toilet paper, brush & sign present
	380	3	EAST	22,9	11.55	Y	1 or 2 flies when container opened; flap closed; toilet paper, cleaner, brush & sign present
NORTH	113	15	SOUTH	25,1	13.15	Y	Only 2 screws on manhole; some flies when opened; toilet locked
	143	14	SOUTH	24,5	13.05	Y	Flies inside when container opened; flap closed; no toilet paper, but brush & sign present
	116	13	WEST	24,7	13.00	Y	Flies inside when container opened; flap open & may not be working, door does not bolt; skid marks on toilet; toilet paper, cleaner, brush & sign present
	141	12	WEST	23,3	12.50	Y	Toilet locked
	117	11	SOUTH	23,3	12.55	Y	Flap closed; toilet paper, cleaner & air freshener present
	43	16	EAST	24,7	13.25	Y	1 or 2 flies when container opened; toilet flap not working?; toilet paper, cleaner, brush & sign present
	41	17	WEST	26,6	13.30	Y	Toilet locked

AREA	DATE: 17 December 1996					WEATHER CONDITIONS: Warm, clear and sunny with a light breeze	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	38	18	WEST	22,2	13.35	Y	1 or 2 flies when container opened; flap open; no toilet paper, but cleaner, compost, brush & sign present
	37	19	WEST	24,6	13.40	Y	Flies when container opened; flap not working?; toilet paper, cleaner, brush & sign present
	48	20	EAST	24,4	13.45	Y	Flies when container opened & flap moved; toilet paper, cleaner & sign present

AREA	DATE: 1 February 1997					WEATHER CONDITIONS: Hot and sunny	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	22,0	9.45	Y	Cobwebs inside container when opened; bottom plate dry; waste on 1st grid only; flies around but probably attracted by dog waste near toilet; toilet paper & newspaper visible. Toilet clean but flap open; toilet paper present.
	802	28	NORTH	21,9	9.55	Y	No significant change inside container. Toilet flap open; toilet brush present but no toilet paper.
	801	29	EAST	21,8	10.00	Y	Waste falling onto 2nd grid; toilet paper only visible. Toilet itself locked.
	728	26	WEST	21,7	9.50	Y	Waste falling on to 2nd grid; toilet paper and newspaper inside. 1 or 2 flies around. Toilet flap open. Chute dirty. Toilet brush and cleaner present, but no toilet paper.
	731	27	WEST	21,6	10.10	Y	Waste falling on to 2nd grid; toilet paper and roll only inside. Toilet itself cleaned earlier by owner with soil; toilet paper, brush and cleaner present. Toilet flap closed and cleaner sprinkled in bowl.
	951	21	SOUTH	22,5	10.40	Y	Toilet paper only inside container. Toilet clean and toilet flap closed; toilet brush, cleaner and compost present, but no toilet paper.
	888	22	SOUTH	22,7	10.35	Y	Waste still mainly on 1st grid; toilet paper and newspaper inside. Toilet clean but toilet flap open. Toilet brush, cleaner and compost present, but no toilet paper.
	891	23	SOUTH	22,8	10.20	Y	Waste falling on to 2nd grid. Toilet itself locked
	944	25	SOUTH	22,5	10.15	Y	Water inside container (1/4 full) - stormwater ? Toilet paper and newspaper visible. Toilet itself cleaned earlier. Toilet flap open and waste on flap. Toilet brush and paper present. Probe and bucket on wall.

AREA	DATE: 1 February 1997					WEATHER CONDITIONS: Hot and sunny	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	946	24	EAST	22,9	10.30	Y	Container quite dry; toilet paper and newspaper inside, especially latter. Toilet flap open and appears not to work. Toilet brush and cleaner present, but no toilet paper.
EAST	273	6	NORTH	25,1	12.00	Y	No significant change inside container. Toilet clean; toilet flap open. Toilet brush present but no toilet paper.
	274	8	NORTH	24,6	11.55	Y	Waste still mainly on 1st grid; container quite dry. Toilet paper and newspaper inside. Toilet clean, but toilet flap open. Toilet paper and brush present.
	271	9	NORTH	25,5	11.45	Y	Waste still mainly on 1st grid and container very dry. Toilet paper only visible. Toilet clean, but chute soiled. Toilet flap open. Toilet paper and brush present. Compost bag outside.
	272	7	NORTH	24,7	11.35	Y	Waste mainly on 1st grid. Toilet paper only visible. Toilet clean and toilet flap closed. Toilet paper and brush present. Compost bag outside toilet.
	275	10	NORTH	23,9	11.50	Y	Waste still mainly on 1st grid and container quite dry. Toilet paper only visible. Toilet clean, but toilet flap open. Toilet paper, brush and air freshener present.
	371	1	SOUTH	22,4	10.50	Y	Waste falling onto 2nd grid. Toilet paper and newspaper inside. Stormwater trench in front of toilet door. Floor painted and walls 1/3 up. Toilet fairly clean; toilet brush cleaner and compost present.
	369	2	NORTH	23,3	11.05	Y	Waste mainly on 1st grid. A little liquid on container floor. Toilet flap closed. Toilet paper, brush and cleaner present.
	364	5	NORTH	24,7	11.20	Y	Waste mainly on 1st grid. Container very dry. Toilet paper and newspaper inside. Toilet itself locked.

AREA	DATE: 1 February 1997					WEATHER CONDITIONS: Hot and sunny	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	365	4	EAST	22,8	11.15	Y	Waste still mainly on 1st grid and container dry. Toilet paper and newspaper visible. Toilet very clean and toilet flap closed. Toilet paper and brush present.
	380	3	EAST	-	-	Y	Gate locked. No access.
NORTH	113	15	SOUTH	26,2	12.40	Y	Toilet paper and newspaper visible. Toilet flap closed but not good fit.
	143	14	SOUTH	25,3	12.35	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Toilet clean and toilet flap closed. Toilet paper and brush present.
	116	13	WEST	23,9	12.25	Y	Some water inside container. Toilet paper visible. May have been worms inside? Toilet door stiff. Toilet flap open - does not close well. Toilet paper, brush and cleaner present.
	141	12	WEST	23,6	12.10	Y	Waste mainly on 1st grid. Container fairly dry. Toilet paper only visible. Toilet itself locked.
	117	11	SOUTH	23,8	12.20	Y	Waste mainly on 1st grid. Container fairly dry. Toilet paper only visible. Toilet flap closed. Carpet and toilet seat cover installed. Toilet brush, air freshener and freshener pills present, but no toilet paper.
	43	16	EAST	24,7	13.15	Y	Waste mainly on 1st grid. Container dry. A lot of toilet paper visible. Toilet clean and toilet flap closed. Toilet paper, brush and cleaner present.
	41	17	WEST	25,5	13.10	Y	Waste on 1st grid. Container dry. Toilet paper and newspaper inside. Toilet clean, but toilet flap open. Flap does not work. Toilet paper and brush present.
	38	18	WEST	23,5	13.00	Y	Waste falling on to 2nd grid. Toilet paper only visible. Small worms or insects inside ? Toilet clean and toilet flap closed. Toilet paper, brush, cleaner and compost present.

AREA	DATE: 1 February 1997					WEATHER CONDITIONS: Hot and sunny	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	37	19	WEST	24,3	12.55	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Worms present recently? Flies around top of wind master. Toilet flap open. Toilet paper, brush and cleaner present.
	48	20	EAST	23,9	12.50	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Carpet and toilet seat cover inside. Toilet clean and toilet flap closed. Toilet cleaner and compost present, but no toilet paper.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
SOUTH	804	30	SOUTH	16,8	08.20	Y	Cobwebs in container when opened. Waste falling on to 2nd grid and even bottom plate which is quite moist. 1 or 2 flies around and faint smell. Toilet paper and newspaper visible. Faecal matter moist in centre, but drier at edges. Physical integrity of unit good. Some subsidence and cracks in soil around toilet, probably along lines of where original pit was dug. One screw missing from manhole cover. Toilet door a bit scratched and dirty. Owner says stormwater comes under door and collects at back of cubicle. Toilet pan lid closed; flap open but working OK. Toilet chute dirty. Toilet paper and organic cleaner present.
	802	28	NORTH	18,0	08.40	Y	Waste falling on to 2nd grid and even bottom plate. Newspaper only visible. Faecal matter moist in centre but drier on edges. Bottom plate moist. Physical integrity of unit good. Faint smell inside cubicle. No toilet paper, but toilet brush present. Toilet number incorrectly labelled on door.
	801	29	EAST	17,3	08.50	Y	Waste falling on to 2nd grid. Water in bottom of container. Toilet paper only visible. Faecal matter dry in a few places. Physical integrity of unit good. Toilet paper, cleaner, brush and compost present. Toilet lid and flap closed. Flap works OK. Toilet number incorrectly labelled on door.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	728	26	WEST	17,6	08.30	Y	Waste falling on to 2nd grid and even bottom plate. Toilet paper only visible. Faecal matter moist in centre, but drier at edges. Bottom plate moist. Physical integrity of unit good. Toilet lid and flap open; flap does not work. Toilet chute dirty. No toilet paper, but cleaner and brush present. Toilet number incorrectly labelled on door.
	731	27	WEST	17,6	09.00	Y	Waste falling on to 2nd grid but still room on top grid as toilet does not seem heavily used. A little water in bottom of container. Toilet paper and newspaper visible. One or two flies around and faint smell detectable. Physical integrity of unit good. Toilet lid and flap closed, but flap works. Toilet paper, cleaner and brush present, but owner says toilet paper not delivered over last few months.
	951	21	SOUTH	17,6	09.15	Y	Waste starting to fall on to 2nd grid, but toilet not heavily used. Toilet and newspaper visible. Faecal matter mainly dry. Physical integrity of unit good. Toilet lid and flap closed. Flap works OK. Toilet chute a little dirty. No toilet paper, but cleaner, brush and compost and small container present.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	888	22	SOUTH	17,9	09.25	Y	Waste falling on to 2nd grid and even bottom plate. Toilet paper and newspaper visible. Faecal matter mainly dry. Physical integrity of unit good. Toilet lid and flap closed but flap open and will not close because of waste piled up on top of it. Toilet itself clean. No toilet paper, but cleaner, brush container, cloth and compost present.
	891	23	SOUTH	17,5	09.55	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter quite moist. 1 or 2 flies around. Physical integrity of unit good. Two screws missing from manhole cover; one replaced by owner. Toilet being cleaned with a little water at time of inspection. Toilet lid open, but flap closed. Flap works OK. Toilet paper, cleaner and brush present.
	944	25	SOUTH	17,3	10.05	Y	Waste falling on to 2nd grid, bit container full of water. Toilet paper and newspaper visible. Faecal matter moist because of water. Soil around bottom of manhole cover. Toilet lid and flap open, but flap works OK. Physical integrity of unit good. Toilet paper, brush, cleaner and bucket and probe present. Linoleum on floor.
	946	24	EAST	18,6	09.30	Y	Waste falling on to 2nd grid. Toilet paper and especially newspaper visible. Faecal matter mainly dry. Toilet does not seem heavily used. Physical Integrity of unit good. Toilet locked.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP °C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
EAST	273	6	NORTH	17,7	11.00	Y (just)	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre, but drier at edges. Physical integrity of unit good. Toilet lid and flap closed, but flap works OK. Toilet clean. Toilet paper and brush present.
	274	8	NORTH	18,6	11.10	Y	Waste starting to fall on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but dry at edges. Physical integrity of unit good. Toilet lid and flap closed, but flap works OK. Toilet clean. Toilet paper and brush present.
	271	9	NORTH	19,3	11.15	Y (just)	Waste starting to fall on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but dry at edges. Physical integrity of unit good. Some soil on bottom of manhole cover and once screw missing. Toilet lid closed, but flap open. Flap works OK. Toilet clean. Floor tiled. Cover on toilet seat. No toilet paper, but brush, air spray and compost present.
	272	7	NORTH	18,3	11.05	Y	Waste starting to fall on to 2nd grid. Toilet paper and newspaper visible. Faecal matter quite dry. Physical integrity of unit good. Some soil on bottom of manhole cover. Toilet lid and flap closed, but flap works OK. Toilet clean. Toilet paper and brush present and compost bag outside toilet.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	275	10	NORTH	18,7	11.20	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. Toilet locked.
	371	1	SOUTH	18,1	10.20	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. Some soil on bottom of manhole cover and one screw missing. Toilet lid closed, but flap open. Flap working OK. Floor and ½ of walls painted. Toilet paper, brush and cleaner present.
	369	2	NORTH	18,7	10.30	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. Toilet floor and door painted. Toilet locked.
	364	5	NORTH	18,6	10.45	Y	Waste starting to fall on to 2nd grid. Toilet paper and newspaper visible. Faecal matter quite dry. Physical integrity of unit good. Toilet lid and flap closed. Flap works OK. Toilet clean. No toilet paper present.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP. ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	365	4	EAST	18,2	10.40	Y	Waste falling on to 2nd grid. Toilet paper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. Toilet lid open, but flap closed. Flap works OK. Carpet on floor. Toilet paper and brush present.
	380	3	EAST	18,0	10.35	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but drier at edges. Physical Integrity of unit good. One screw missing from manhole cover. Toilet lid and flap open. Flap does not work. Toilet clean. Toilet paper, and spare roll, brush and cleaner present. Compost bag outside toilet.
NORTH	113	15	SOUTH	18,0	11.30	Y	Waste starting to fall on to 2nd grid. Toilet paper only visible. Faecal matter fills grid but is quite dry as compost liberally applied. Some water in bottom of container. Physical integrity of unit good. Two screws missing from manhole cover. Toilet lid closed, but flap open. Flap does not work. Toilet paper and cleaner present.
	143	14	SOUTH	18,0	11.40	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. One screw missing from manhole cover. Toilet lid closed but flap open. Flap works OK. Toilet clean. Toilet paper, brush and cleaner present.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	141	12	WEST	18,6	11.55	Y	Waste starting to fall on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. Toilet locked.
	117	11	SOUTH	18,2	11.50	Y	Waste starting to fall on to 2nd grid. Toilet paper only visible. Faecal matter quite dry. Physical integrity of unit good. Toilet locked.
	43	16	EAST	18,8	12.15	Y	Waste starting to fall on to 2nd grid. Toilet paper visible. Faecal matter moist in centre but drier at edges. Physical integrity of unit good. Toilet lid and flap closed, but flap works OK. No toilet paper, but cleaner and brush present.
	41	17	WEST	19,2	12.10	Y	Waste still mainly on upper grid. Toilet paper and newspaper visible as well as plastic bag. Faecal matter quite dry. Physical integrity of unit good, but cracks in earth around manhole cover on right hand side. Toilet lid closed, but flap open. Flap does not work. No toilet paper, but cleaner and brush present.
	38	18	WEST	18,8	12.05	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter quite moist. Physical integrity of unit good. Toilet lid and flap closed. Flap works OK. No toilet paper, but cleaner, brush and compost present.

AREA	DATE: 15 March 1997					WEATHER CONDITIONS: Cloudy and overcast with little wind (after week of rain)	
	STAND NO	TOILET NO	ASPECT	AIR TEMP ^{0}C IN MANHOLE	TIME	WINDMASTER TURNING	REMARKS
	37	19	WEST	18,8	12.05	Y	Waste falling on to 2nd grid. Toilet paper only visible. Faecal matter moist. Physical integrity of unit good. Toilet lid closed but flap open. Flap works OK. Toilet clean. Toilet paper, cleaner and brush present.
	48	20	EAST	18,7	12.00	Y	Waste falling on to 2nd grid. Toilet paper and newspaper visible. Faecal matter moist. Physical integrity of unit good. Toilet lid and flap closed. Flap works OK. No toilet paper, but cleaner, brush and compost present.

WEATHER CONDITIONS

CONDITIONS PREVAILING AT WEATHER STATIONS FOR THE "TWO WEEK" PERIOD PRIOR TO MONITORING

GK = Goudkoppies Wastewater Treatment Works
JA = Johannesburg Airport
VR = Vereeniging

DATE	18/05/96			01/06/96			22/06/96			06/07/96			20/07/96		
	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR
MIN TEMP (°C)	6	5	3.6	5	2.3	-0.2	4	0.5	-5.7	2	1	-5.9	0	-2.5	-6.2
MAX TEMP (°C)	26	23	25.1	19	20.5	22.6	20	20.9	22.7	20	20.6	22.7	18	18.3	20.5
AVE TEMP (°C)	14.6	13.4	13	11.5	11.7	10.3	11.8	11.2	10	11.4	8.9	8	6.1	6.5	5.6
TOT RAIN (mm)	6	23.4	9.4	3	0.6	0	3	2.2	0	0	0	0.2	2	0	1
AVE WIND (m/s)		4.8	3.6		3.6	3.9		5.7	5		4.9	4.2		5.7	4.8
AVE HUMIDITY (%)		55.5	67.4		58.4	63.5		54.1	54.3		40.1	44.1		58.9	58.1

DATE	03/08/96			17/08/96			31/08/96			14/09/96			28/09/96		
	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR
MIN TEMP (°C)	0	0.9	0.9	0	-3.3	-4.2	3	-0.5	-0.4	5	1.7	0.1	2	1.2	-1.4
MAX TEMP (°C)	20	21.1	23.2	22	23.1	24.3	24	24.8	26.6	27	29.3	31.1	26	28	29.2
AVE TEMP (°C)	10.8	10.9	11.8	11.4	10.9	10.9	12.9	12.8	13.1	17.3	16.5	16.1	16.1	15	16.2
TOT RAIN (mm)	0	1	0	9.4	7.2	1.2	0	5.5	5	0	0	0	0	0.4	0
AVE WIND (m/s)		7.6	8.8		8.9	6.9		7	6.1		8	7.4		10.9	11.6
AVE HUMIDITY (%)		59.6	50.3		54 2	45.4		49.9	44.1		30.1	28.7		48.6	42.8

DATE	12/10/96			26/10/96			09/11/96			23/11/96			07/12/96		
	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR
MIN TEMP (°C)	5	9.3	8.9	9	6.3	8.1	12	7.7	8.3	10	5.1	3.5	8	10.3	11.7
MAX TEMP (°C)	27	29.5	31.8	27	29.1	30	30	30.7	32.5	27	28.6	29.8	27	28.5	30.2
AVE TEMP (°C)	20	19.7	20.4	17.9	18.3	19.6	20.8	20.4	21.6	16.9	17.4	18	18.5	18.5	19.5
TOT RAIN (mm)	7.5	4.4	13	38.4	22.4	26	30.4	20.5	11.8	81.2	63.8	38.8	69.7	78.6	51
AVE WIND (m/s)		9.1	8.9		10.7	10.2		9.1	8		9.6	9.4		8.8	10.5
AVE HUMIDITY (%)		42.5	40.2		59.7	50		57	43.3		69.6	62.8		70.4	59.2

WEATHER CONDITIONS

CONDITIONS PREVAILING AT WEATHER STATIONS FOR THE "TWO WEEK" PERIOD PRIOR TO MONITORING

GK = Goudkoppies Wastewater Treatment Works
JA = Johannesburg Airport
VR = Vereeniging

DATE	18/01/97			01/02/97			15/02/97			01/03/97			15/03/97		
	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR
MIN TEMP (°C)	15.1	15	15	16.1	15.3	15.7	15.9	14.8	14.7	15.9	15.8	14.8	16.1	6.2	15.3
MAX TEMP (°C)	24.1	24.3	24.7	24.5	26.4	28.1	26.6	26.8	26.9	26.4	28.1	29.8	22.7	23.8	24.1
AVE TEMP (°C)	19.6	19.7	19.9	20.3	20.8	20.6	21.3	20.8	20.8	21.1	21.9	22.3	19.4	20	19.7
TOT RAIN (mm)	65.4	63.9	22.2	41	61.5	3.8	34	22.2	22.2	0	3.2	5.2	194.2	204.9	115.6
AVE WIND (m/s)		7.4	6.9		5.6	5.1		5.1	5.6		6.9	6		5.3	6
AVE HUMIDITY (%)		75.2	66.1		61.9	52.4		61.7	51.6		64.9	51		83.9	70.1

DATE	05/04/97			19/04/97			03/05/97			17/05/98			31/05/97		
	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR	GK	JA	VR
MIN TEMP (°C)	11.1	12.7	11.8	9	8	6.3	6.1	7.4	5.3	5.9	5.1	2.2	6.3	4.7	3.2
MAX TEMP (°C)	18.1	20.6	22.4	18.9	19.4	21.6	18.1	19.7	22	18.1	18.1	20.4	15.7	14.4	15.9
AVE TEMP (°C)	14.6	16.7	17.1	14	13.7	14	12.1	13.6	13.7	12	11.6	11.3	11	9.5	9.5
TOT RAIN (mm)	73.2	134.6	58	5.5	4.8	2.2	0	13	20	24	0	2	94.2	96.8	87
AVE WIND (m/s)		6.6	5.4		6.1	4.1		6.3	5.1		4.1	2.8		6.4	6
AVE HUMIDITY (%)		82	72.3		58.6	62.8		62.2	66.1		58.1	62.5		70.6	75.5

APPENDIX G

USER EDUCATION LITERATURE

ENVIRO LOO OPERATIONAL

TRAINING MANUAL FOR COMMUNITY SERVICE CONTRACTOR

An integral part of your duties as the Project supervisors and ultimately as the community service contractors for the Enviro Loo Sanitation system, is to inform each household receiving an Enviro Loo, how the Enviro Loo works and how it should be maintained. If treated properly the Enviro Loo will give many years of odour free and trouble free service.

1. How does the Enviro Loo work?

The Enviro Loo is a dry composting sanitation system that has been developed in South Africa, in order to offer a respectable, hygienic and efficient sanitation system where a waterborne system is not available due to its enormous capital expense and due to a severe shortage of water resources throughout large part of South Africa.

The recommended capacity of the Enviro Loo is not more than 8 to 10 users per day.

The Enviro Loo operates by separating the solid and liquid waste that enters the container through the toilet pan. Due to the ventilation through the sealed container the urine (Liquid waste) is eliminated by evaporation. Over a period of time the solid waste dries and decomposes into a dried compost like matter. The air (oxygen) that circulates through the system causes the aerobic bacteria to be stimulated and allows for quicker drying and decomposition of the waste. The continual ventilation of the system causes the pathogens and germs that can cause health problems to die off.

The gradual drying of the solid waste causes shrinkage of the mass. As a result it is only necessary to remove the dried waste matter every 12 to 18 months.

Items such as sanitary pads, plastic bags and other non organic items should be disposed of with the domestic refuse. However if some pads are dropped into the Enviro Loo by mistake it will not affect the system, but they will NOT decompose and will have to be extracted when the waste matter is removed, or after the waste matter has been through the additional composting process.

2. How does the Composting system work?

Non pathogenic bacteria and other natural micro-organisms are introduced into the Enviro Loo when the system is installed, other organisms that occur naturally in human body waste constantly augment the bacteria supply. All these organisms feed on the body waste and gradually turn into compost.

It is recommended that each household with an Enviro Loo purchases a bag of organic mixer from the community retail outlet, which in all probability will be the community service contractor.

A double handful of the organic mixer should be put in to the Enviro Loo, through the toilet pan, on a weekly basis. This will assist the decomposition and drying process. Vegetable waste matter, grass, etc can also be used for this purpose.

Under NO circumstances should any liquid other than urine be introduced into the Enviro Loo.

3. Cleaning of the Enviro Loo

NEVER clean the toilet pan with JIK, JEYES FLUID or HARPIC. All these detergents will destroy the natural bacteria colonies in the Enviro Loo, which means that the Enviro Loo process will cease to operate .

As the community service contractor you will be able to supply the Enviro Loo toilet cleaner to the individual households.

The Enviro Loo toilet cleaner is a dry powder which is spread around the inside of the toilet pan and then wiped off with a damp toilet brush. Toilet brushes are an additional appliance product that can be supplied through the community retail outlet. The toilet brushes must be stored in a water container to clean the brush. The water in the container should be changed on a daily basis.

Each household will also be supplied with an operational manual detailing the operation and maintenance of the system..

4. Complaints Reporting.

Report all complaints regarding the Enviro Loo system to the community service contractor/maintenance staff who will assist as far as possible to solve whatever problem. In the unlikely event that the local service contractor cannot solve the problem they will contact the supplier.

5. On-going Enviro Loo maintenance.

As the community sanitation service contractor you will be responsible for providing a very valuable service to your community. You will have the constant and long term back-up of Enviro Options (Pty) Ltd to ensure the success of the Enviro Loo system.

The Enviro Loo's under your control should be inspected every 3 months.

During the inspection note the amount of waste matter on the grid and how much waste is on the drying plates closest to the collection box. No material need be removed from the tank until there is a significant amount of matter on the drying plates near the collection box.

The liquid level should not rise above the level of the final drying plate due to the constant evaporation of the liquid waste via the ventilation of the system. If liquid appears at this level it will be necessary to pump out the water trap below the drying plates. A hole is provided below the collection box for inserting the end of the hose into the water trap.

As stated above the liquid should not reach this level. If it occurs check with the owner if anyone is pouring liquid through the toilet pan e.g., dirty washing water. This must be discouraged and explained to the household that it should be discontinued.

At these routine inspections check that the:

* Windmaster is still positioned properly and turning freely.
* That the outlet vent pipe is in its correct position.
* That the fly gauze over the inlet pipes is still in position.

At the end of the inspection ensure that the manhole cover is properly secured.

The inspection must be noted in the report back i.e., address, date of inspection, status of Enviro Loo and if any problems has occurred.

6. Procedure for the removal of solid waste matter.

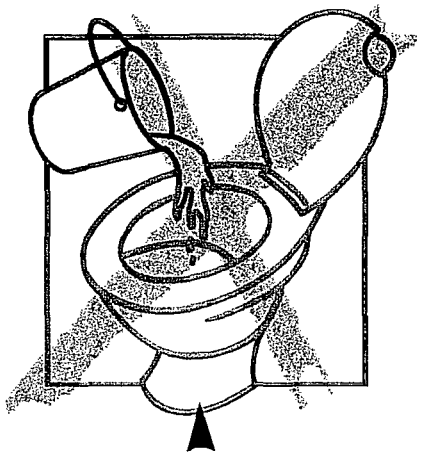
1. Open the manhole cover.
2. Scrape the dried waste matter resting on the last drying plate into the collection box with the rake.
3. Lift the collection box out of the manhole cover once filled to capacity, by means of the handle on top of the box.
4. Tip the contents into the box trailer. Repeat the procedure if necessary.
5. Using the rake remove any foreign material from the container such as stones, plastic bags, dried sanitary towels or non - composted paper.
6. Note the date when the toilet was emptied and the house address. Also note any unusual conditions in the toilet at the time. These details should then be put into the community service schedule.
7. Once the trailer is full of waste matter it should be deposited at the central composting works, where it will be further treated.

If there are any problems which cannot be solved these must be referred to the manufacture.

THIS IS AN ENVIRO LOO COMPOSTING TOILET

IN ORDER TO ENSURE MAXIMUM EFFICIENCY, PLEASE FOLLOW THESE INSTRUCTIONS.

DO NOT!

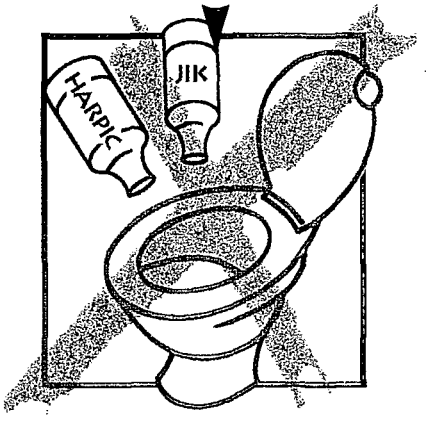


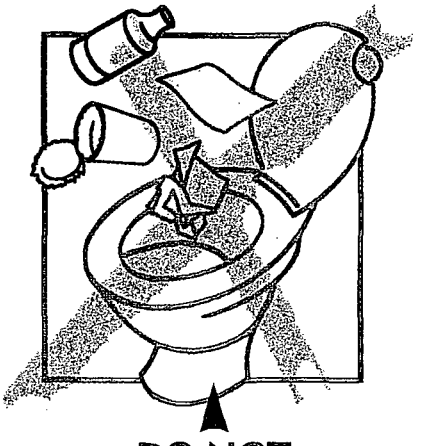
DO NOT

POUR WATER INTO THE TOILET FOR CLEANING OR ANY OTHER PURPOSE.

DO NOT

USE CHEMICALS IN THE TOILET FOR EXAMPLE JIK OR HARPIC





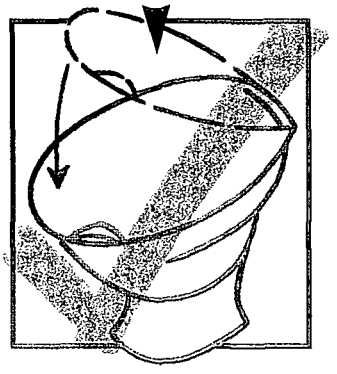
DO NOT

THROW PLASTIC BAGS, BOTTLES, TINS ETC. INTO THE TOILET.

YOU SHOULD!

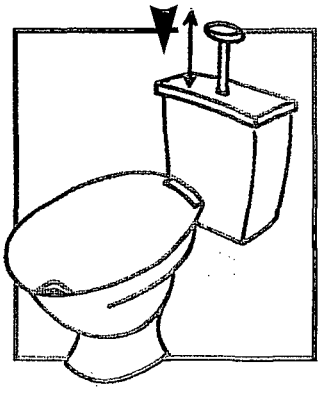
YOU SHOULD

KEEP THE TOILET LID CLOSED WHEN NOT IN USE.



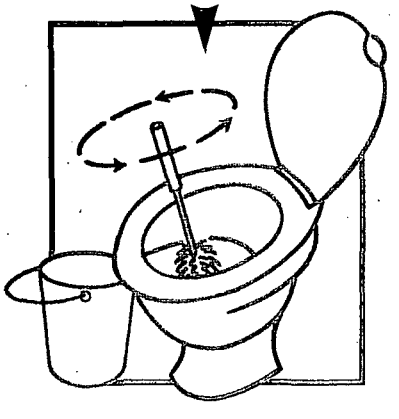
YOU SHOULD

LIFT AND PUSH DOWN THE AERATOR HANDLE AFTER USE



YOU SHOULD

CLEAN THE TOILET WITH THE ENVIRO LOO TOILET CLEANER AND CLEAN OFF WITH A DAMP BRUSH

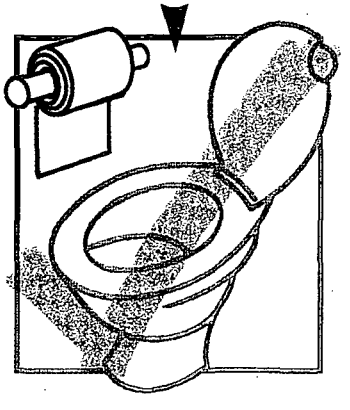


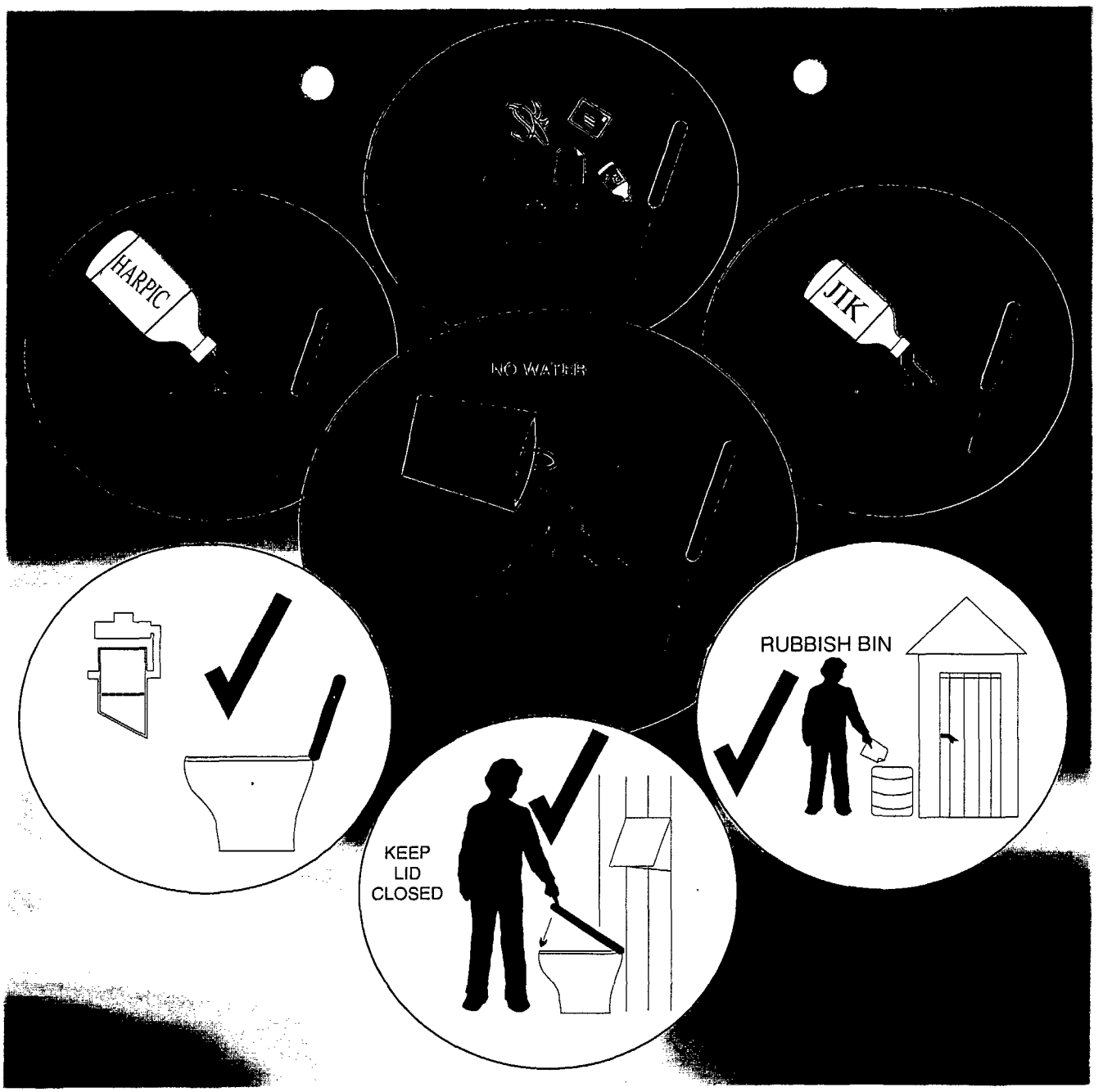
YOU SHOULD

ADD ADDITIONAL ORGANIC MIX INTO THE TOILET ONCE EVERY TWO WEEKS

YOU SHOULD

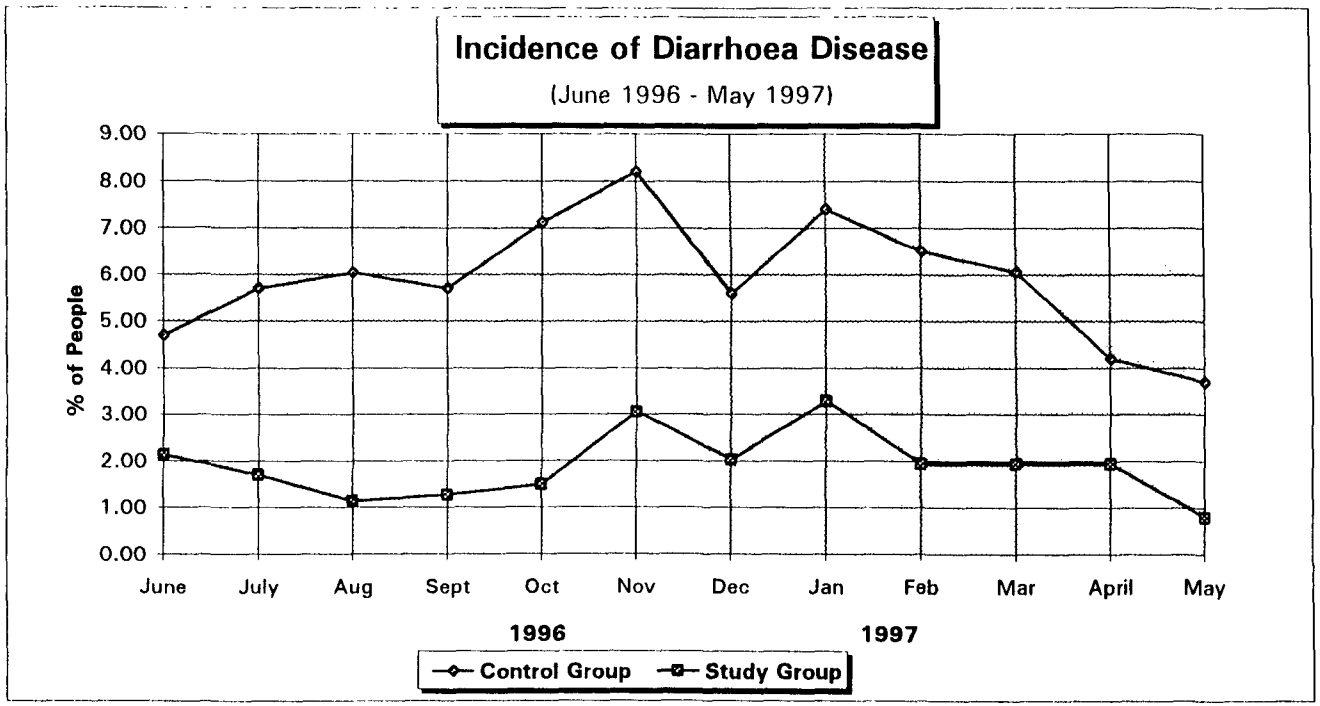
USE TOILET PAPER




HARPIC
NO WATER
JIK
RUBBISH BIN
KEEP
LID
CLOSED

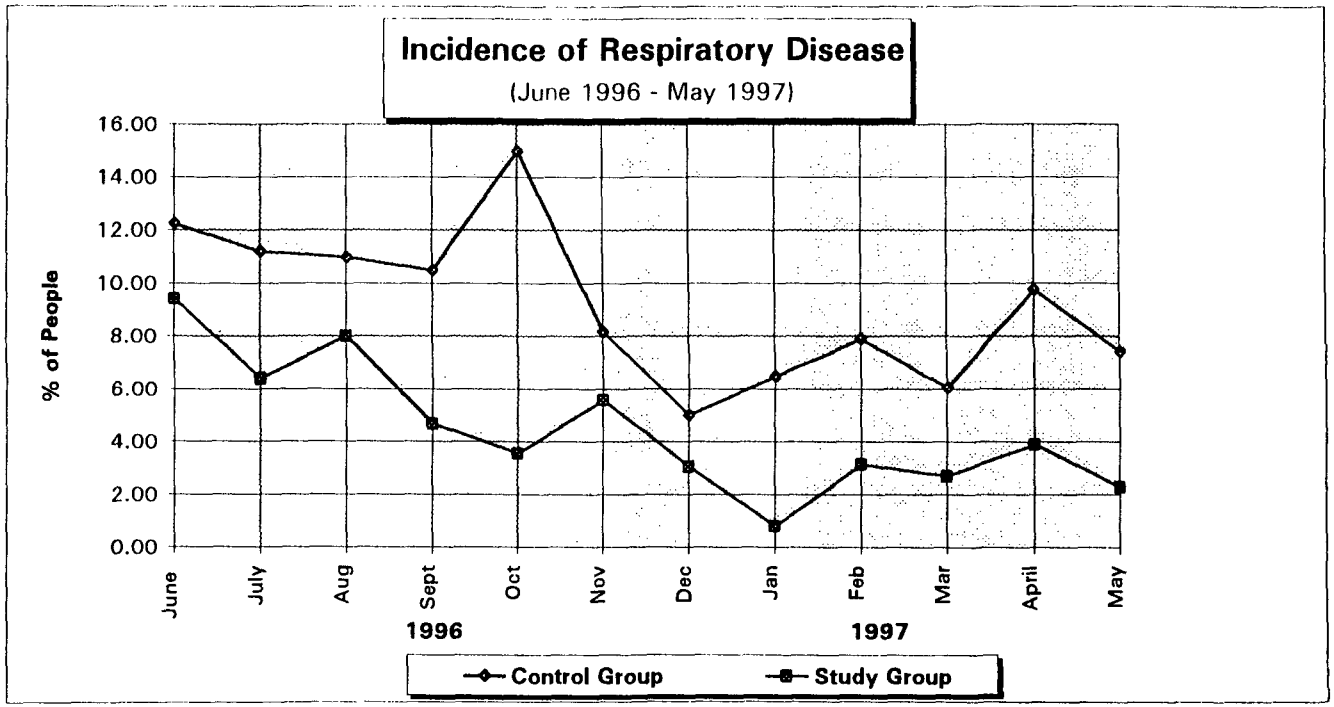
APPENDIX H

RESULTS OF HEALTH IMPACTS



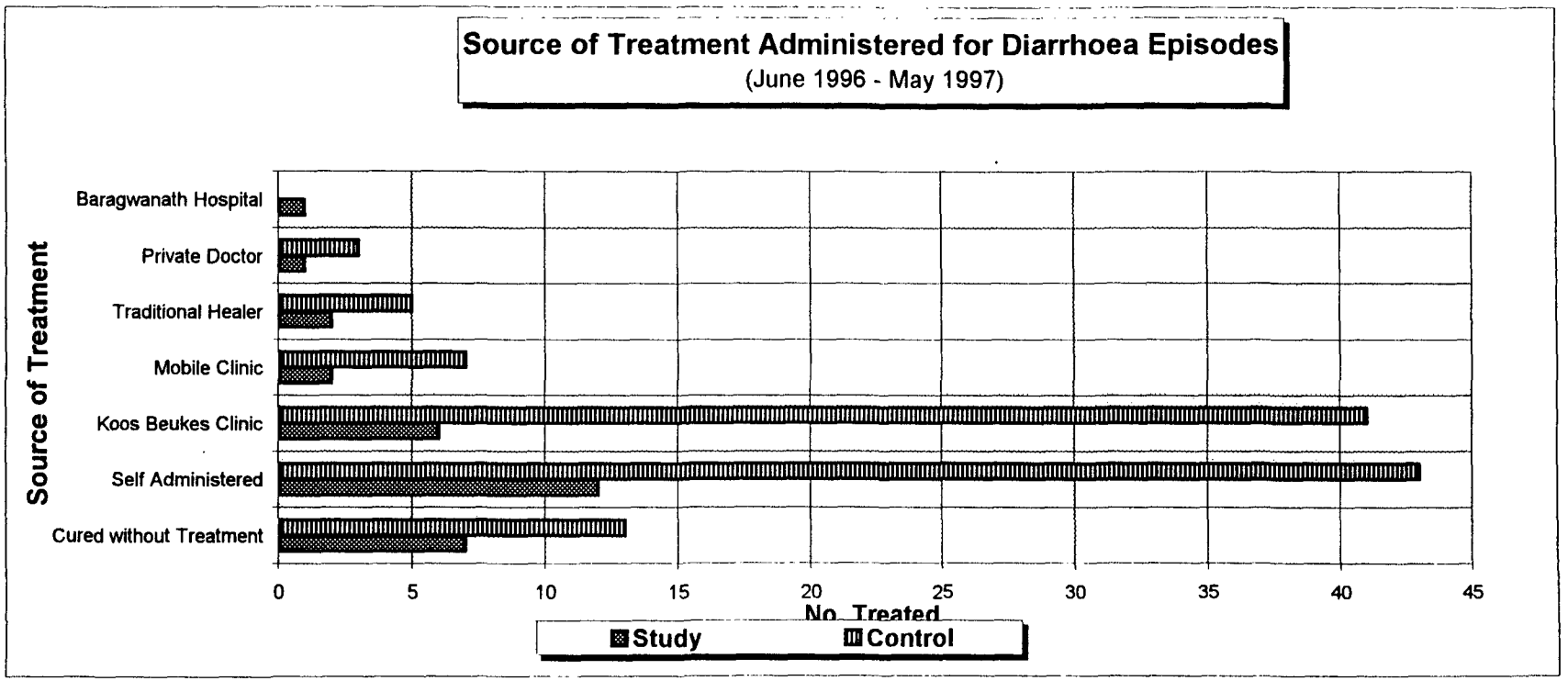
	1996							1997				
% of People Infected	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Control Group	4.70	5.70	6.03	5.71	7.12	8.20	5.60	7.40	6.50	6.05	4.20	3.70
Study Group	2.14	1.71	1.14	1.28	1.50	3.06	2.04	3.30	1.95	1.95	1.95	0.80

H1

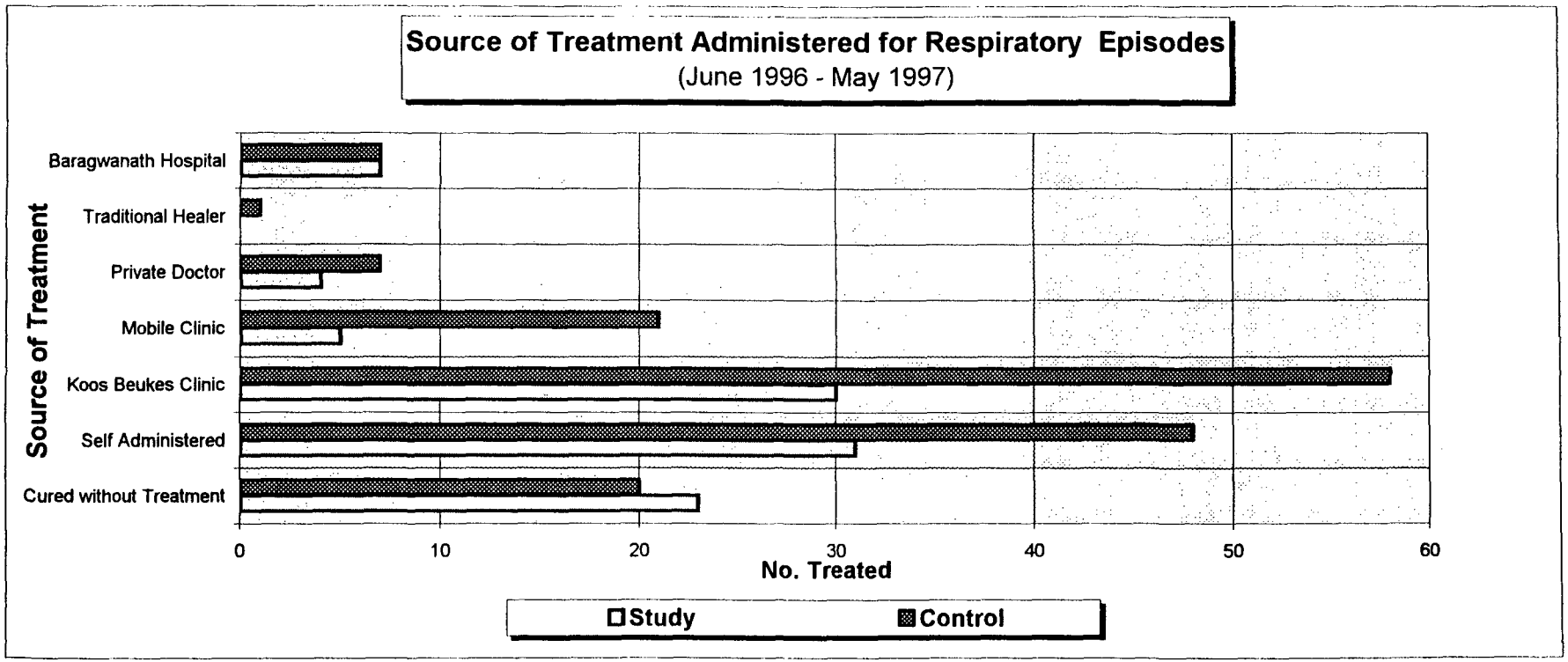


	1996							1997				
% of People Infected	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Control Group	12.23	11.18	10.96	10.48	15.00	8.15	5.00	6.50	7.90	6.05	9.75	7.43
Study Group	9.41	6.41	7.98	4.70	3.57	5.60	3.06	0.80	3.15	2.70	3.90	2.30

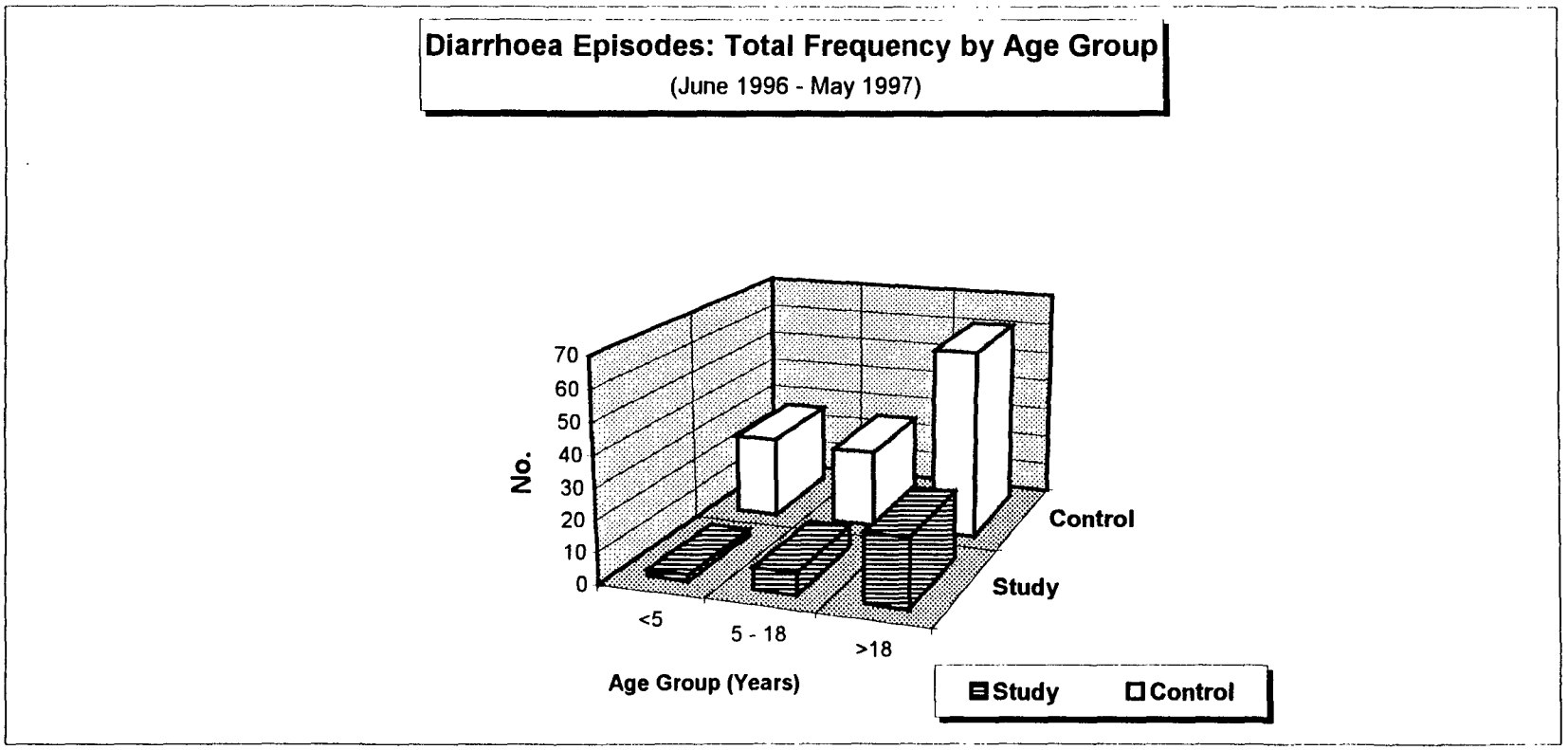
H2



Source of Treatment	Study	Control	% (Study)	% (Control)
Cured without Treatment	7	13	22.58	11.61
Self Administered	12	43	38.71	38.39
Koos Beukes Clinic	6	41	19.35	36.61
Mobile Clinic	2	7	6.45	6.25
Traditional Healer	2	5	6.45	4.46
Private Doctor	1	3	3.23	2.68
Baragwanath Hospital	1	0	3.23	0
Total	**31**	**112**		

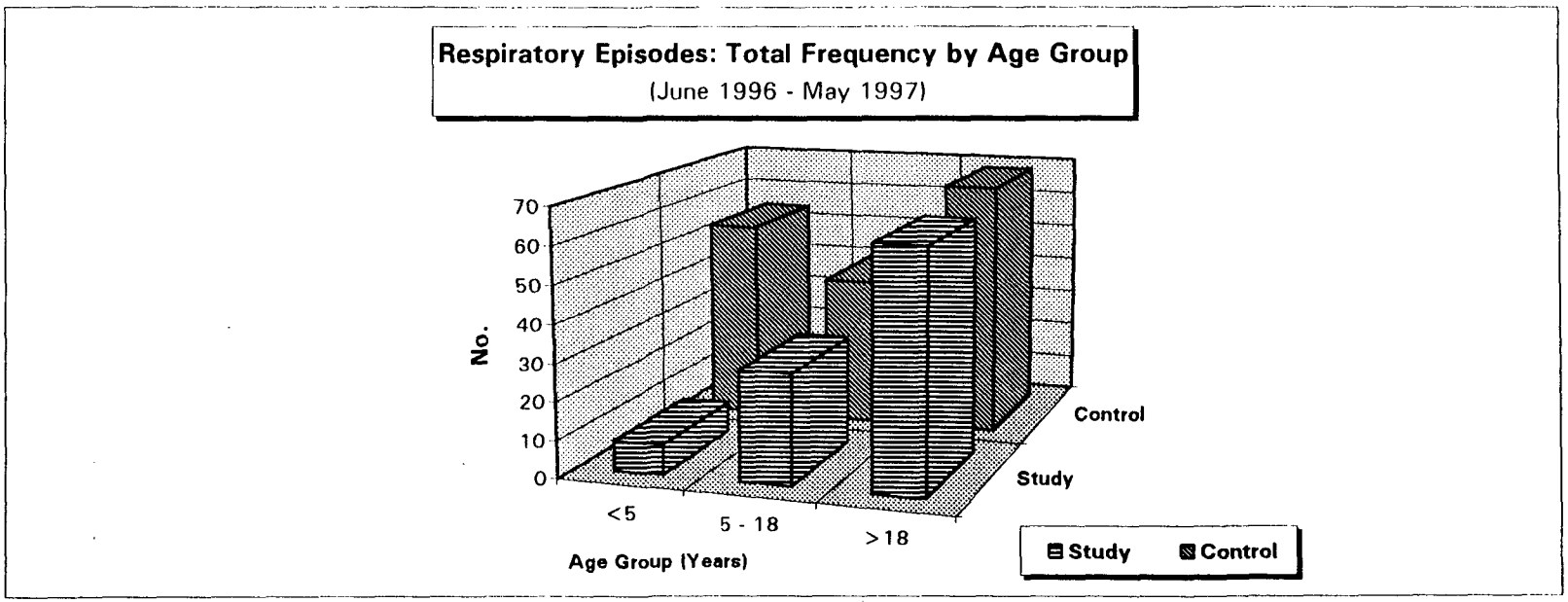


Source of Treatment	Study	Control	% (Stu)	% (Cont)
Cured without Treatment	23	20	23	12.35
Self Administered	31	48	31	29.63
Koos Beukes Clinic	30	58	30	35.80
Mobile Clinic	5	21	5	12.96
Private Doctor	4	7	4	4.32
Traditional Healer	0	1	0	0.62
Baragwanath Hospital	7	7	7	4.32
Total	**100**	**162**		



Distribution of Episodes of Diarrhoea: Total Frequency by Age Group

Age Group (Years)	Study	Control	% (Study)	% (Control)
< 5	2	26	6.5	23.2
5 - 18	7	25	22.6	22.3
> 18	22	61	71.0	54.5
Totals	**31**	**112**		

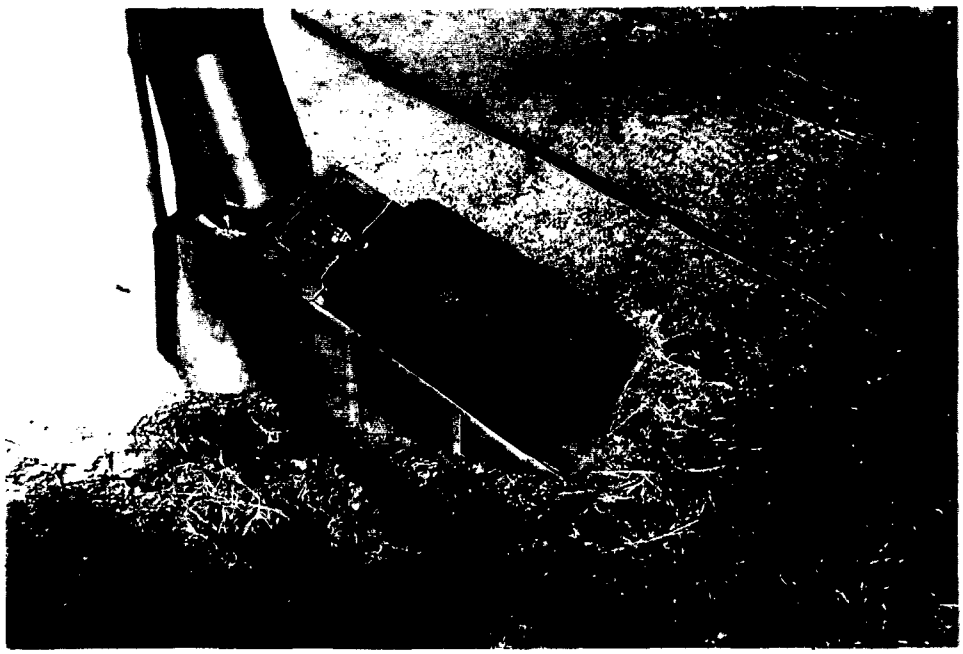


Distribution of Episodes of Respiratory Disease: Total Frequency by Age Group

Age Group (Years)	Study	Control	% (Study)	% (Control)
<5	8	54	8	33.3
5 - 18	29	40	29	24.7
>18	63	68	63	42
Totals	100	162		

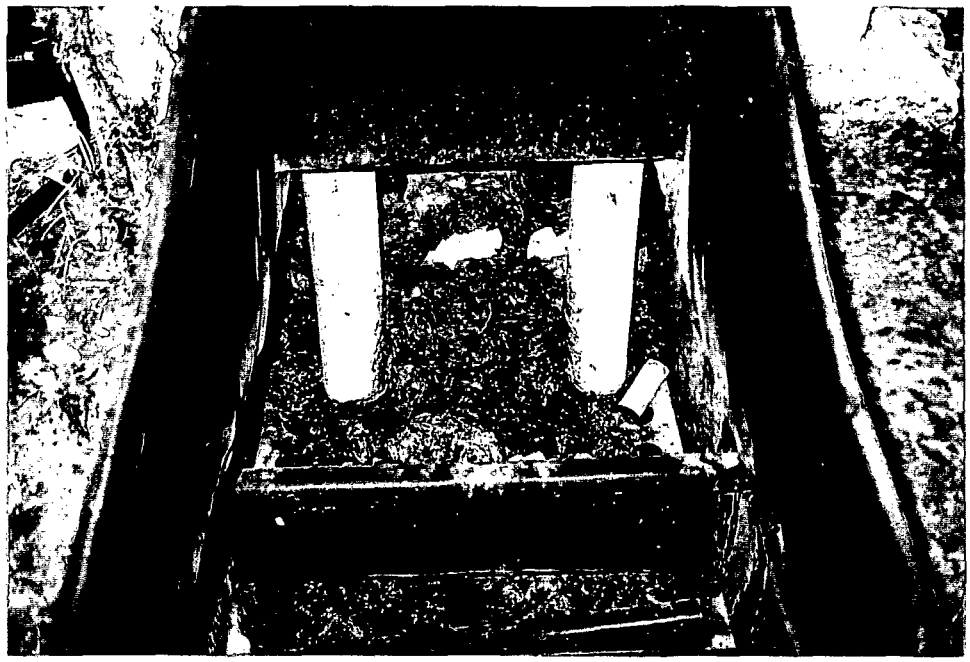
APPENDIX I

PHOTOGRAPHS OF ENVIRO LOO LATRINES AT THE END OF THE TRIAL PERIOD (JUNE 1997)

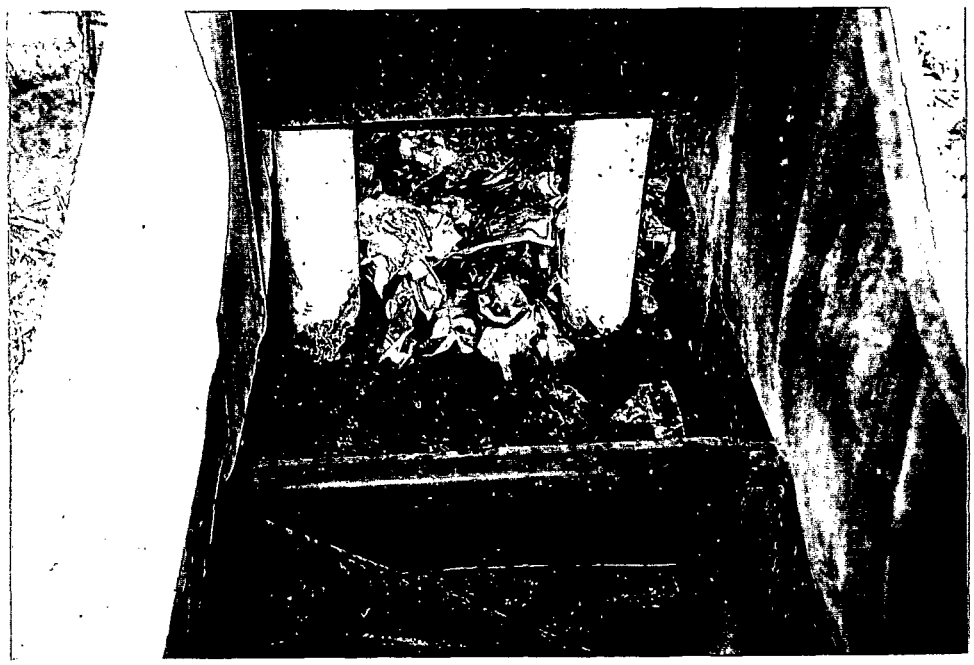


Photograph I : Subsidence of ground around Enviro Loo latrine container

Photograph J : Stormwater control structure erected by Enviro Loo latrine user



Photograph K : View of typical waste pile in Enviro Loo latrine container (June 1997)

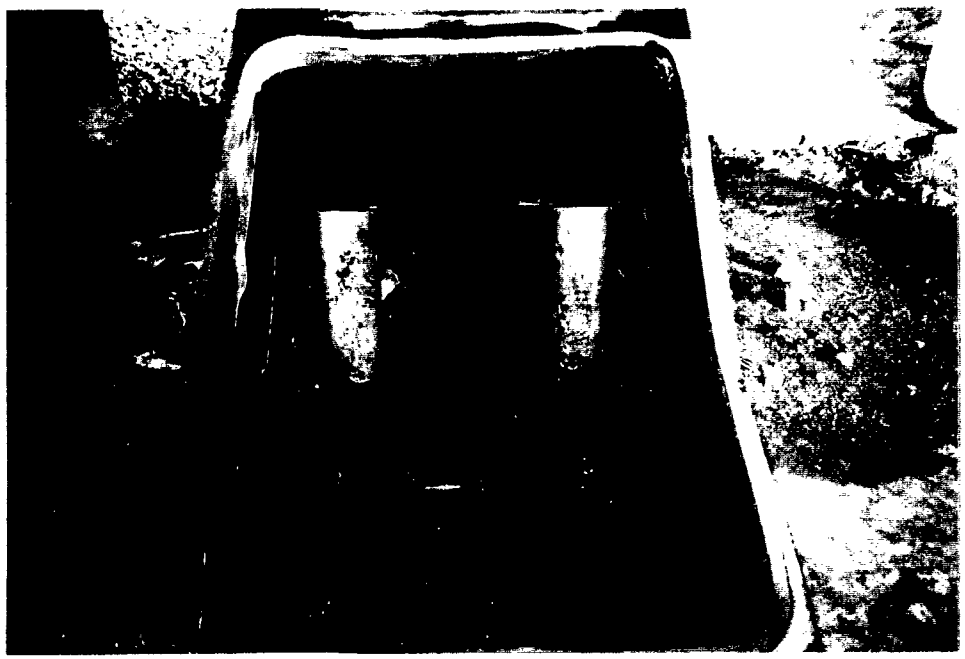


Photograph L :

View of latrine container contents (June 1997) showing heavy use of newspaper as an anal cleansing material

Photograph M :

View of temperature probe inside waste pile in latrine container (June 1997)



Photograph N : Flooded latrine container as a result of incorrect wastewater disposal

APPENDIX J

WASTE ANALYSES FROM THE ENVIRO LOO LATRINE CONTAINERS (JUNE 1997)

COMPOSTING LATRINE WASTE SAMPLES : FIELD TEST RESULTS (14 JUNE 1997)

Stand No.	Time	Temperature in Waste Pile		pH*				Remarks
		Top Grid	Second Grid	Grid Sampled	Time Sampled	Time Read	Read-ing	
804	7.28	5.0	4.0	Top	7.55	8.57	8.8	Water in container, moist
728	7.30	6.0	6.5	Top	8.40	9.40	8.6	Water, maggots ,moist & crumbly
802	7.35	2.0	2.0	Second	8.20	9.20	7.2	Dry, crusty
801	7.42	6.0	6.5	Top	8.57	10.00	7.8	Water
731	9.03	6.0	5.5	Top	9.10	10.17	7.3	Water
888	9.18	4.0	4.5	Top	9.25	10.25	7.0	Water
951	9.50	2.5	3.0	Top	9.50	10.50	8.8	
891	10.12	5.0	4.5	Top	10.12	11.12	8.5	
946	10.18	4.0	4.5	Top	10.25	11.23	7.9	Water quite fresh
944	10.33	4.5	6.0	Top	10.35	11.35	7.6	Water very fresh
371	11.05	4.5	4.5	Top	11.12	12.14	7.9	Crusty, dry
369	11.17	2.5	3.0	Second	11.23	12.28	7.8	Not much on second grid
380	11.35	4.5	4.0	Top Edge	11.43	12.43	8.5	Moist
365	11.50	6.0	5.0	Top edge	12.00	13.05	7.4	Dry
364	12.07	6.0	-	Top	12.10	12.12	7.5	Very dry - moist inside. Nothing on second grid
273	12.27	6.0	5.5	Top	12.35	12.40	7.7	Quite fresh
272	12.40	2.5	3.5	Second	12.52	12.48	7.3	Reasonably fresh
274	13.05	3.5	4.0	Top	13.10	13.18	8.3	Dry crust, moist underneath, flies
271	13.17	7.0	6.0	Top	13.23	4.20	7.9	Dry, composty
275	13.34	5.5	5.0	Top	13.40	14.43	8.0	
141	14.33	5.0	5.0	Top	14.35	15.35	8.7	Moist
117	14.45	5.0	-	Top	14.57	14.55	7.5	Nothing on second grid. Ash, composty
116	15.07	5.0	5.5	Second	15.12	16.12	7.6	Quite fresh
143	15.20	4.5	5.0	Top centre	15.27	16.40	7.2	
113	15.33	3.5	5.5	Top	15.37	16.40	7.0	Water
48	15.55	4.5	4.5	Top	16.04	16.02	7.8	Composty, quite fresh
37	16.05	9.5	7.0	Second	16.17	15.21	7.6	Moist, quite fresh
38	16.23	5.0	5.5	Top	16.35	16.52	7.0	Moist
41	16.52	5.5	-	Top	16.52	16.52	7.1	Nothing on second grid
43	17.00	4.0	3.5	Top	17.05	18.00	7.1	
Average		4.8	4.6				7.7	

* pH :20 g (moist) + 10 ml distilled water, read after 60 minutes.

COMPOSTING LATRINE WASTE SAMPLES : LABORATORY VISUAL OBSERVATIONS

STAND No.	GRID SAMPLED	COLOUR	TEXTURE	COMPOSITION AND MICROBIOLOGICAL OBSERVATIONS
38	Top	Black, greenish to light brown patches.	Very soft and wet, uniform.	Paper, larvae, pupae, small red spiders, fungi.
38	Second	Black / brown.	Wet, very soft.	
117	Top Middle	Dark rich brown.	Moist, crumbly.	Small spiders (red). Straw or grass.
117	Top Edge	Dark brown. White patches - paper and possible fungus.	Dry, compacted and hard. Some crumbly patches.	Paper, pupae.
272	Top	Dark brown. Ochre patches. Black patches.	Moist but firm.	Mostly faeces, pupae.
272	Second	Dark brown, lighter brown patches.	Very moist, very soft.	
365	Top Middle	Dark brown. Black patches.	Very soft and moist.	Black - possibly fungi. White fungi as well.
365	Top Middle	Dark brown. Black patches.	Very soft and moist.	Paper.
802	Top	Dark brown. Black patches - possibly fungi.	Moist partly soft, some hard lumps.	Fungi - possibly straw. Pupae present. Small red spiders. Bark. Small amounts of plastic.
802	Second	Very dark brown.	Course and crumbly.	White patches, possible fungi or paper remnants. Straw.
888	Top	Black.	Soft, very moist, uniform consistency.	Segmentated worms (larvae).
888	Second	Black.	Large hard lumps.	Straw, fungi, little red spiders. Old paper.

GENERAL REMARKS:

A more uniform and finer "crumble" from a waste sample seemed to be associated with the presence of straw. A more uneven texture and larger, very hard lumps were associated with the presence of paper. The fungi present could possibly have grown after the waste was removed from the latrines, as the samples incubated for several days in plastic bags. The pupae and worms observed are commensurate with sewage sludge, and none appeared to be parasitic in origin (microscopic observation).

MICROBIOLOGICAL ANALYSIS AND PARASITOLOGY ASSAY ON COMPOSTING LATRINE WASTE SAMPLES

STAND NO	SAMPLE	MOISTURE %	AEROBIC PLATE COUNT PER 1G WET SAMPLE	ANAEROBIC PLATE COUNT PER 1G WET SAMPLE	ANAEROBIC/ ANAEROBIC RATIO	FAECAL COLIFORMS PER 1g WET SAMPLE	SALMONELLA QUALITATIVE	ASCARIS - TOTAL OVA COUNT PER 1g DRY SAMPLE	ASCARIS VIABILITY
38	Top	68.02	520×10^5	720×10^3	80	4 500	absent	12	Not counted
38	Bottom	77.97	260×10^5	$1\,100 \times 10^5$	72	3 800 000	absent	32	Not counted
117	Middle Top	60.95	650×10^5	590×10^4	11	330 000	absent	893	47% viable, 45% potentially infective, 53% dead
117	Top Edge	36.75	390×10^5	200×10^4	20	600	absent	1 508	79% viable, 79% potentially infective, 21% dead
272	Top	63.76	720×10^5	590×10^4	12	370 000	absent	17	Not counted
272	Bottom	73.33	330×10^5	720×10^5	0,45	1 900 000	absent	37	59% viable, 57% potentially infective, 41% dead
365	Middle Top	68.23	390×10^4	$*720 \times 10^2$	0,56	160 000	absent	170	64% viable, 64% potentially infective, 36% dead
365	Top Edge	65.35	520×10^5	$*650 \times 10^3$	80	12 000	absent	9	Not counted
802	Top	35.24	$1\,500 \times 10^5$	460×10^2	326	11 000	absent	46	25% viable, 25% potentially infective, 75% dead
802	Bottom	62.33	$1\,100 \times 10^5$	330×10^5	3,0	3 400 000	absent	204	40% viable, 34% potentially infective ,60% dead
888	Top	70.23	$4\,100 \times 10^3$	$5\,900 \times 10^3$	0,71	10 000	absent	74	100% dead
888	Bottom	23.09	$2\,900 \times 10^5$	330×10^4	88	41 000	absent	25	100% dead
NORTHERN WORKS COMPOST		49.00	NS	NS	NS	<10	-VE	-VE	
GUIDELINE LIMIT		NA	NA	NA	NA	100	-VE	O	

NS = Not Sampled NA= Not Applicable

* The anaerobic jar containing these samples did not seal properly. Whilst the interior was not entirely anaerobic, it was also not entirely aerobic. At best these organisms should be considered as facultative anaerobes.

NOTES:

Ascaris eggs that are observed to contain dividing cells are considered viable. Eggs containing larvae are potentially infective.

Samples that contain very few eggs are not counted. Even though no eggs have been counted, all eggs present are considered as live since the samples are fresh faeces. Samples having dead.

COMPOSTING LATRINE WASTE SAMPLES (14 JUNE 1997)

CHEMICAL ANALYSIS

Stand No	Grid Sampled	Moisture (%)	Total Solids (g/kg)	Volatile Solids (g/kg total solids)	COD (g/kg)	Total Kedjahl Nitrogen (g/kg)	Total Phosphorus (g/kg)	Ammonia (g/kg)	Ortho-Phosphate
38	Second	78,0	220,3	621,1	10,0	27,5	32,5	3,5	2,9
117	Top Edge	36,8	632,5	396,4	76,8	12,5	47,5	0,22	1,0
117	Top Middle	61,0	390,6	424,1	52,4	13,5	50,0	0,34	3,2
272	Second	73,3	266,7	535,2	18,0	22,5	21,0	1,1	3,0
365	Top Edge	65,4	346.5	475,0	16,4	16,5	55,0	1,0	4,1
802	Second	62,3	376,7	484,5	57,6	18,5	55,0	0,38	2,6
888	Second	23,1	769,1	491,5	76,0	23.0	32,5	3,0	3,7
Compost average		49,0	510,0	459,6	NS	19,5	29,0	NS	NS

NS = Not Sampled

COMPOSTING LATRINE WASTE SAMPLES (14 JUNE 1997)

METAL ANALYSIS

SAMPLE I.D.		CONCENTRATION (mg/kg)												
Stand No.	Grid Sampled	Cadmium as Cd	Cobalt as Co	Chromium as Cr	Copper as Cu	Mercury as Hg	Molybdenum as Mo	Nickel as Ni	Lead as Pb	Zinc as Zn	Arsenic as As	Potassium as K	Selenium as Se	Boron as B
38	Second	4,0	3,5	151	10,7	<8,0	<3,0	12,7	23,9	400	< 14	7 400	< 24	< 3,0
117	Top Edge	12,1	11,1	102	22,4	<8,0	3,7	33,1	73,3	1 300	<14	12 800	<24	<3,0
117	Top Middle	8,8	8,0	82,0	17,7	<8,0	3,3	15,8	55,9	1 400	<14	4 900	<24	<3,0
272	Second	7,0	5,5	57,1	15,7	<8,0	3,2	19,4	40,1	820	<14	14 200	<24	<3,0
365	Top Edge	11,7	8,9	112	26,3	<8,0	6,7	39,3	62,1	1 200	<14	12 600	<24	<3,0
802	Second	14,1	13,7	109	24,0	<8,0	4,4	40,2	78,1	1 600	<14	9 000	<24	<3,0
888	Second	6,4	6,7	54,8	12,7	<8,0	<3,0	21,4	32,6	685	<14	17 000	<24	<3,0
Average		9,2	8,2	95,4	18,5	<8,0	3,9	27,4	52,3	1 058	<14	11 129	<24	<3,0
Compost Average		21	17	153	302	<8,0	5,0	47	104	1 240	<14	3 17	<24	<3,0
Guideline limit		15,7	199	1 750	50,5	10	25	200	50,6	353,5	15	NA	15	80

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NA = Not Applicable