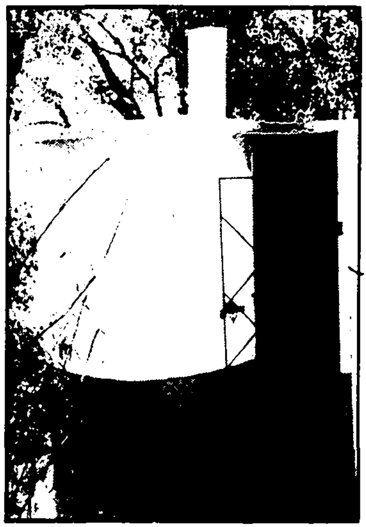
THE VALLEY TRUST

WATER AND SANITATION PROJECTS

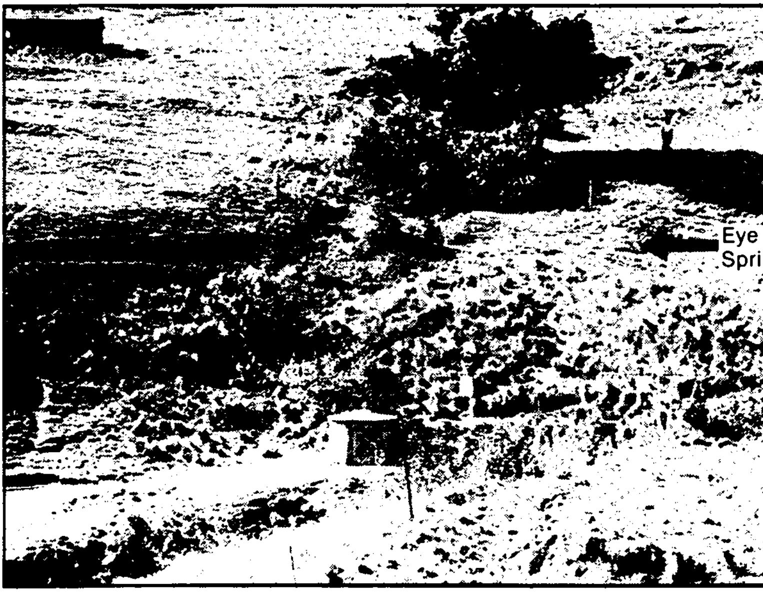
by Chris Mann

A ferro-cement rain-water tank



An improved pit-toilet

A description of The Valley Trust's Water and Sanitation projects in 1985, midpoint of the International Drinking Water Supply and Sanitation Decade.



A spring protection. The eye of the spring is in the fenced-off area above the reservoir tank

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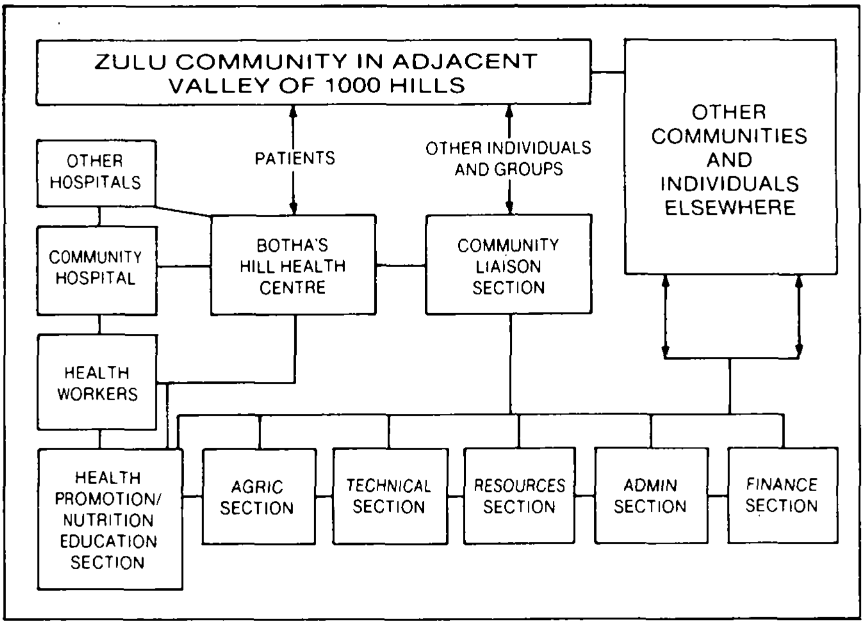

The Valley Trust takes an holistic approach to health. It traces the roots of illness in its operational area to a multiplicity of interlinked factors, such as malnutrition, poor water, illiteracy, etc. It is of the utmost importance, therefore, that a patient is exposed to the full range of self-help activities offered by The Valley Trust, as shown by the referral chain illustrated above. The water and sanitation projects are only part of this broad holistic approach. See Introduction.

INTRODUCTION

The Valley Trust is a non-government organisation that promotes health among the Zulu people in the Valley of a Thousand Hills outside Durban, South Africa. It believes that the causes of disease, particularly the diseases of deficiency associated with underdeveloped communities in the Third World, are found in a wide range of interlinked factors. Poor formal education, unemployment, migrancy, illegitimacy, discriminatory legislation, unhealthy diets and inadequate water and poor sanitation are a few threads in the complex web of poverty.

The Valley Trust's holistic approach to this complexity expresses itself through its organisation into eight sections such as Agriculture, Natural Resources, Community Liaison and Technical. Although this booklet describes the water and sanitation projects of the Technical Section, the presence of the other sections should not be forgotten by the reader. Specialised projects, working in isolation at a single, narrowly defined community need are normally of limited, short term effect.

The lack of sanitation, clean water and employment in rural and peri-urban areas in Southern Africa is well-known. The Valley Trust's Technical Section attempts to tackle these problems in a project that links the construction of ferrocement roof tanks, improved pit toilets, spring protections and a community-run piped water supply. Local Development Committees employ men trained by The Valley Trust to build roof tanks and toilets. Spring Protections are carried out by a two-man Valley Trust team. The Technical Officer visits these projects in the field in a manner similar to an Agriculture Extension Officer. This method of technology transfer is set out in Chapter 7 and the organisation of the piped water supply is described in Chapter 6.

The purpose of this monograph, however, is not to describe the work of The Valley Trust's Technical Section in detail. We wish instead to give an overview, setting out in broad outline the various linked projects. Where an aspect is innovative and not described in current literature, detail is presented in, for example, the description of the triple-purpose tank mould and the backward-sloping pedestal mould. There is an abundance of excellent technical publications about ferrocement, spring protection, pit toilets and community piped water supply and a short bibliography of these is supplied for readers who wish to acquaint themselves further with them.

This monograph, therefore, is directed towards those involved in development in rural and peri-urban areas. It is not a training manual so much as a guide for planners and administrative staff in private, community and government organisations. These groups will probably find the difficulties and loopholes described in the section on technology transfer of some interest. In particular it is meant to assist the sponsors of technical trainees to The Valley Trust to support the latter on their return following the practical course currently available.

The author would like to acknowledge the contributions made by the following:

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Chris Zithulele Mann
Director (Administration)

THE VALLEY TRUST
October 1985

PREFACE

HEALTH AND WATER IN THE VALLEY OF A THOUSAND HILLS

(First part of a paper delivered at the Second Carnegie Inquiry into Poverty and Development in South Africa at the University of Cape Town, 1984. Reprinted with permission of South African Labour and Development Research Unit, School of Economics, University of Cape Town. The date was obtained in a prevalence survey conducted on 384 households selected in random cluster samples during 1980).

by

Dr. I.B. Friedman

Medical Director and Community Medical Officer,

THE VALLEY TRUST

Domestic water is a precious commodity in the Valley of a Thousand Hills, KwaZulu. While there is a moderately good summer rainfall in the area, water is often difficult to obtain from the springs, rivers and streams located far down in the valleys between the hills. The task of fetching water is left to women and children, who have modified ancient traditions by using 25 litre polypropylene water containers to carry water to their homesteads. The most usual method of collecting the water is to scoop it in a shallow bowl, usually a plastic or enamel dish and ladle it into the 25 litre carrying container. The expenditure of human time and energy in moving these heavy loads of water is considerable.

Adult men are very rarely responsible for carrying water, yet make all decisions regarding the siting of homesteads. The homesteads are predominantly located on plateaus above the valleys, sited for ease of access to the roads. They are poorly sited with regard to water supply. One of the factors militating against improvement in the supply and distribution of water is this relative priority placed by the men, as decision makers, on access to transport and work rather than water supply.

Water Usage

The number of 25 litre containers used by the average household is 3.98 containers. (SD = 1.67 SEM = 0.09 95%CL = 3.8 to 4.20. This is the equivalent of approximately 99.5 litres per household per day. The per capita consumption of water carried to the household is estimated to be 10.88 litres/person/day.

In estimating total water consumption account has also to be taken of the fact that the washing of clothes and a certain amount of personal hygiene occurs at the water source, particularly in the rural households. The amount of water used in this situation cannot be easily be measured or estimated.

The goal set by the UN Water and Sanitation Decade 1981-1990 is for every person to have reasonable access to 50 litres/day.

Water Quality:

The origin of water supply is shown in Figure (1). Community standpipes account for the largest supply to the area as a whole, but still leave some 60% of the population depending on a local water supply. Piped water supplies are drawn principally from

a) the major Durban aqueduct which is a raw water source that happens to pass obliquely through the area

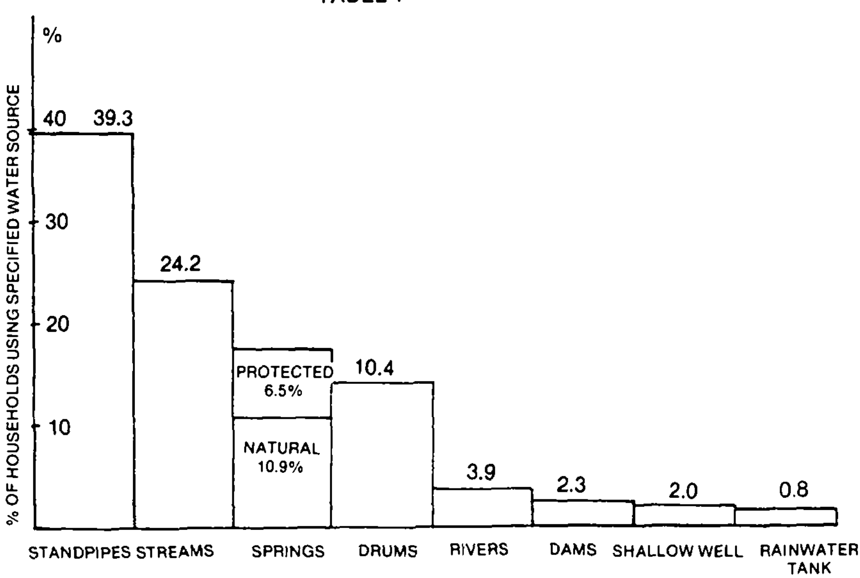
b) new installed community standpipes in the Embo, Ngcolosi and Molweni areas closest to the urban white areas of Hillcrest. The quality of this water is the highest in the Valley as the water is drawn from the Pinetown Regional Water Supplies Corporation, and free of contamination.

DISTRIBUTION OF WATER USAGE BY ZONE

Litres/person	Number of zones
7	2
8	5
9	8
10	8
11	3
12	3
13	3
14	1
15	1
16	1
17	1

Mean = 10.88
Modes = 9 & 10
Median = 10
Mid-range = 12

TABLE 1



TYPE OF WATER SUPPLY
Figure 1.

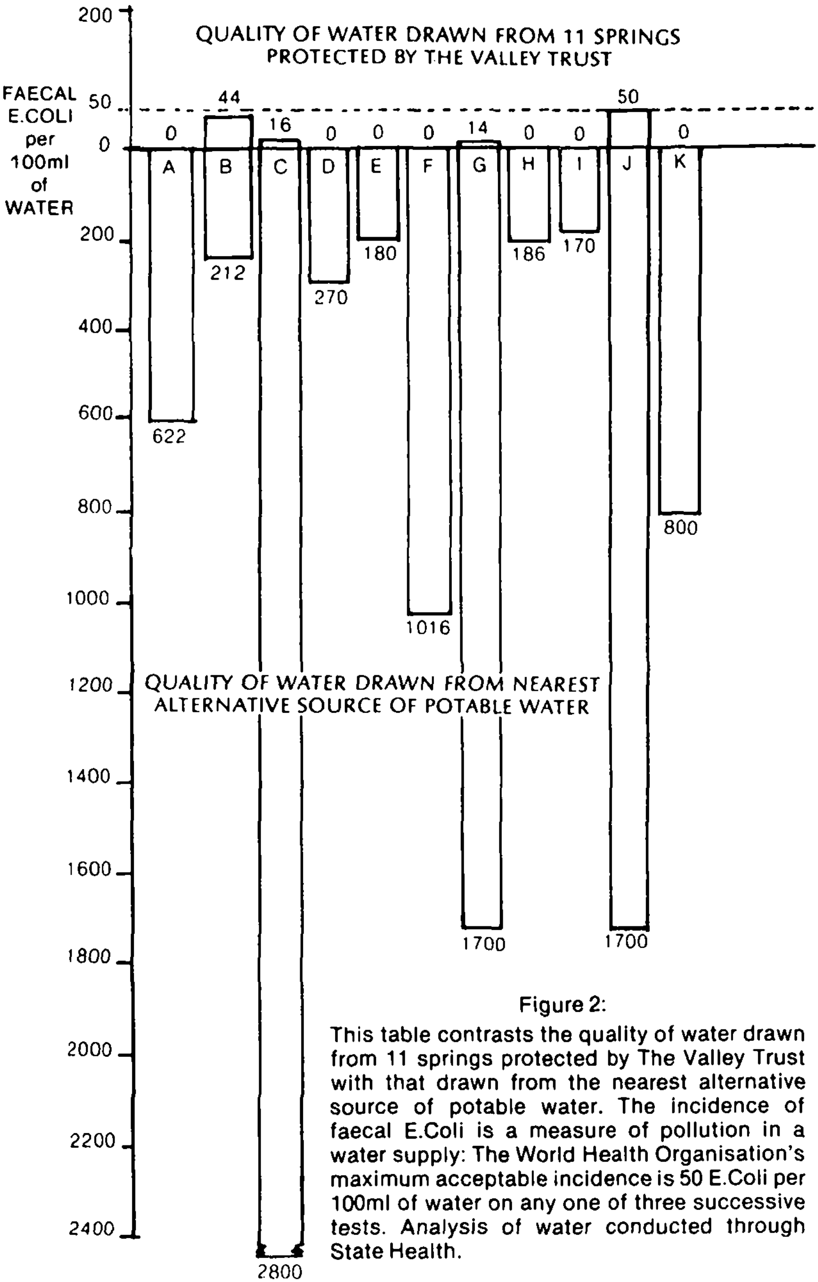


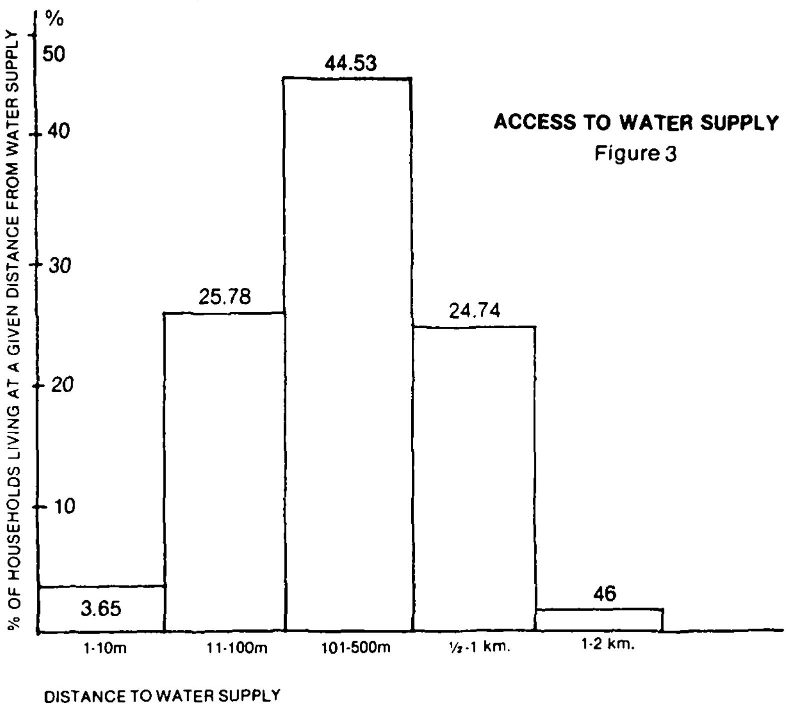
Figure 2:
This table contrasts the quality of water drawn from 11 springs protected by The Valley Trust with that drawn from the nearest alternative source of potable water. The incidence of faecal E.Coli is a measure of pollution in a water supply: The World Health Organisation's maximum acceptable incidence is 50 E.Coli per 100ml of water on any one of three successive tests. Analysis of water conducted through State Health.

In the areas where water from standpipes is available, however, it is only obtainable in narrow zones close to these sources. The only other major source of water supply that can be considered reasonably safe for human consumption are Protected Springs (used by 6.5% of Households). These are the result of a recent water improvement programme undertaken by the Valley Trust. The majority of the population are therefore drinking unsafe water. There are 30.4% drawing water from rivers, streams and dams, water sources that are usually considered as most unsatisfactory, particularly when water is not disinfected.

Fig. (2) compares faecal contamination in unprotected water sources to that of springs protected by The Valley Trust's method of spring protection. It is notable that 64% of the Protected Springs showed no faecal contamination, and of the remainder none showed more than 50 E. Coli per 100ml of water. It has been suggested that a level of 50 E.Coli per 100ml of water is not an unreasonable standard for a rural unchlorinated water supply. What is of striking significance is that the protected water sources are approximately ten-fold less contaminated than alternative water supplies used for water consumption.

Access to water:

The median distance to the usual source of water supply is between 101 and 500 meters. Approximately a quarter of the households have to travel more than 1/2 kilometer. Only 3.65% had water within 10m of their household, which is readily understood since very few households have an individual water supply, although many do collect rainwater in 40 gallon drums. A summary of the access to water supply is shown in the histogram in Figure (3). Using the UN Water Conference criteria for urban areas of "reasonable" access being within 200m of a public standpipe, it appears that approximately half of the population do not have reasonable access to drinking water.



ACCESS TO WATER SUPPLY
Figure 3

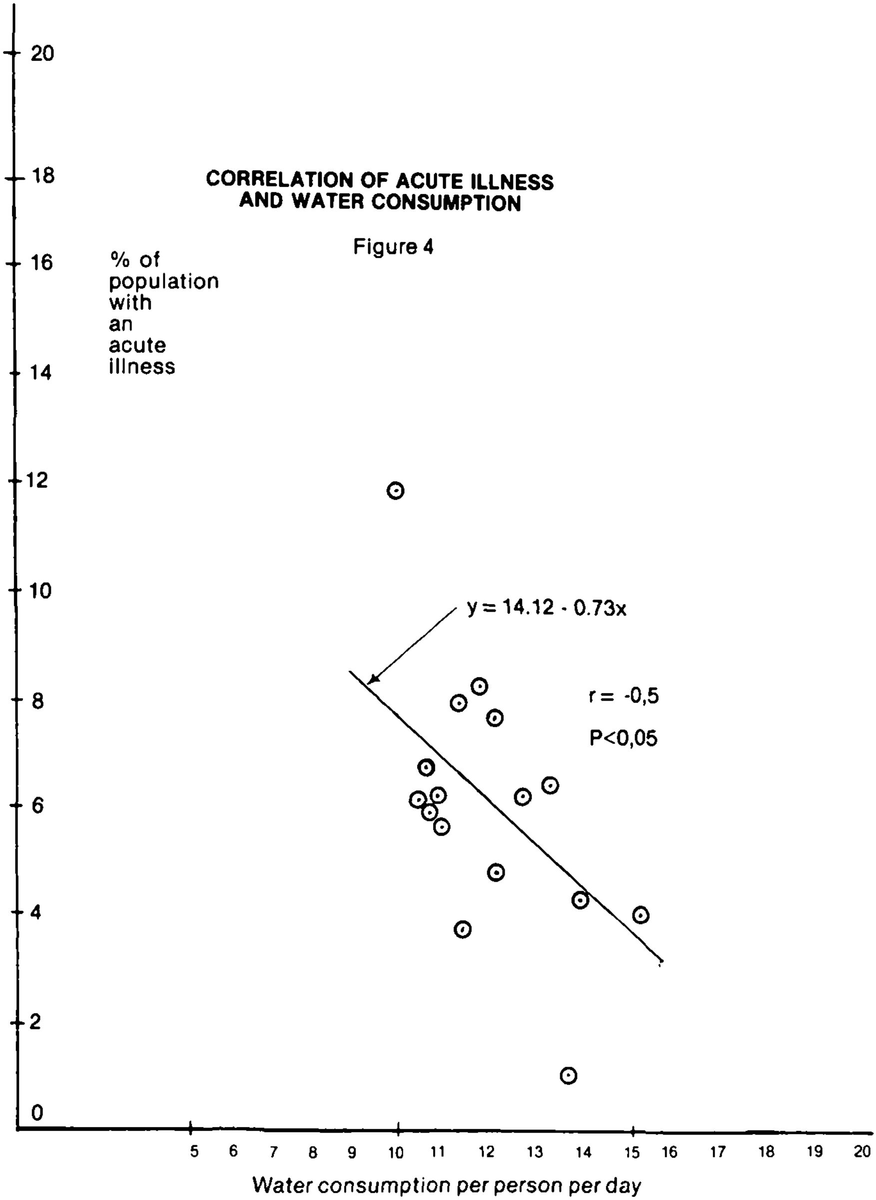
The effect of water in relation to health.

Correlation between the volume of water used per person in each of the zones of the study area and the prevalence of acute illness in that zone revealed a statistically significant association Fig. (4).
The correlation coefficient (r) was -0.5 and is significant for $p<0.05$.

The slope of the regression curve is

$$y = 14.1 - 0.73x$$

This tends to confirm findings reported by Feachem et al that the volume of water used by a household has significant effect on its morbidity. Households consuming more water per person tend to have less acute illness.



The association between the volume of water used by a household and acute illness can be explored further.

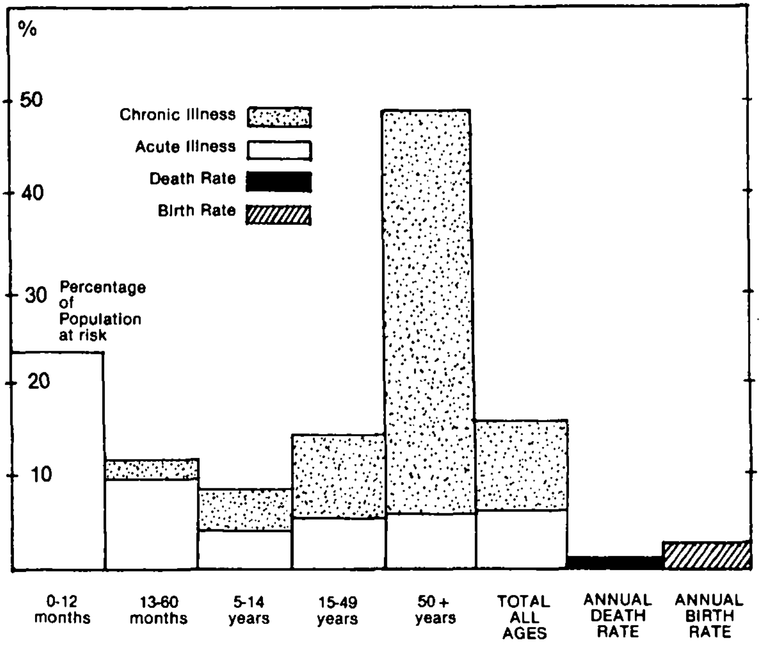
Fig. (5) shows the distribution of acute illness by age group. It will be noted that young children and in particular infants below the age of one year, are particularly vulnerable to acute illness. Almost a quarter of infants are acutely ill at any one time; a prevalence two and a half times as large as the next age group the 1-4's.

If one examines the actual symptomatology associated with the acute illness in infants one is hardly surprised to discover that Diarrhoea is the leading symptom. The five most important symptoms are:

Diarrhoea	52.2%
Dry Cough	30.4%
Fever	30.4%
Vomiting	26.1%
Poor Appetite	17.4%

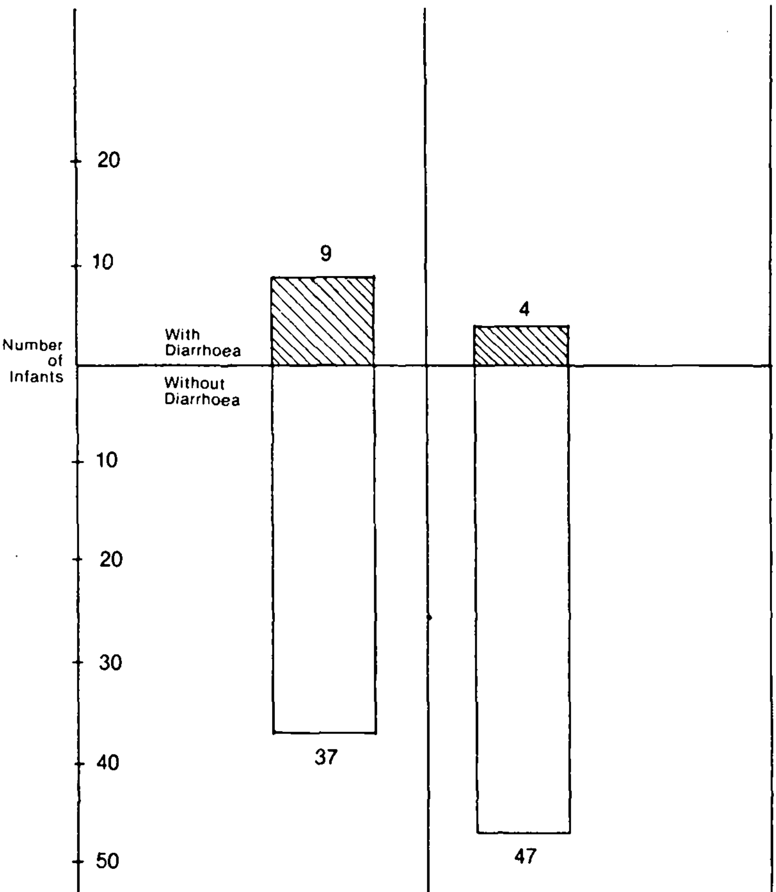
It is therefore reasonable to infer that it is mainly the diarrhoea in infants that leads to the finding of a positive correlation between water volume and acute illness.

Figure 5 **DISTRIBUTION OF ILLNESS BY AGE**



Based on the probable causative linkage between infantile diarrhoea and water volume used in the household, the hypothesis was tested that a statistically significant relationship existed.

Figure (6) which indicates diagrammatically the results of a chi-squared tests on the proportions of infants with or without diarrhoea, depending on whether these infants came from households with a relatively low (9 litres or less) compared to a relatively higher (10 litres or more) per capita water consumption. The difference in diarrhoea rates is fairly marked:- 19.6% for the low consumption group compared to 7.8% for the higher consumption group. This difference is just significant mainly because of the low percentage of infants in relation to the rest of the population and the effect that this has on the number of infants included in the study.



Water Consumption	Low	Higher
Per Capita	⩽9 Litres	⩾10 Litres
Diarrhoea Rate	19.6%	7.8 %
	$X^2 = 2.9$	$0,05 < p < 0,1$

Figure 6: **THE EFFECT OF WATER CONSUMPTION ON DIARRHOEA RATES**

Further graphic evidence of this relationship is demonstrated in a cumulative frequency curve Fig. (7), which shows the percentage of infants with diarrhoea in households where the per capita water consumption figure is less than the given amount. At lower consumptions the percentage of infants with diarroea is relatively high, but this drops rapidly with an increase in the water supply. Regretably, the bulk of infants come from households that have low consumption, and this adds additional significance to the finding. It can be seen for example that about 50% of the infants come from a household consuming 10 litres or less. These infants are prone to develop diarrhoea at a greater rate.

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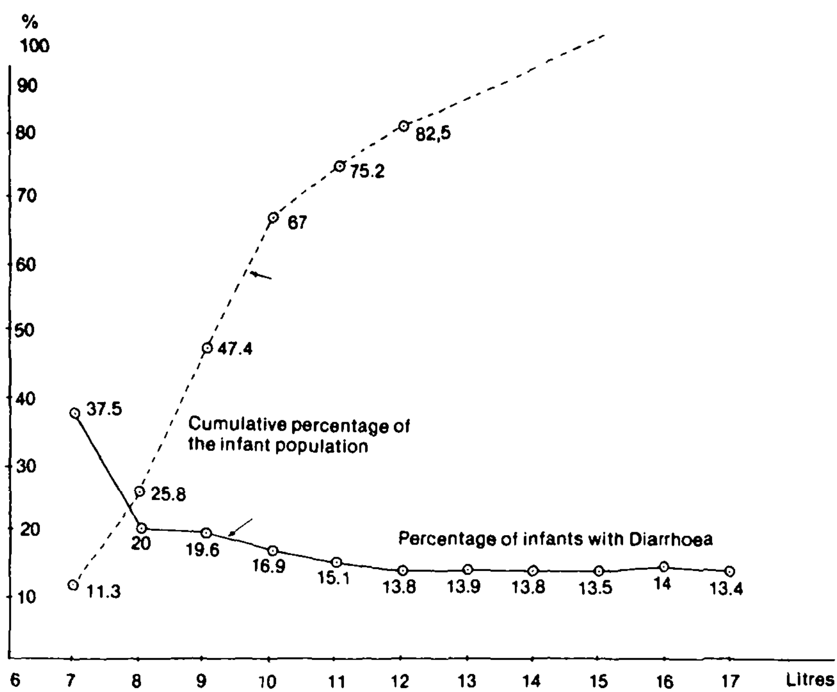


Figure 7: **CONSUMPTION IN LITRES OF WATER PER CAPITA EQUAL TO OR LESS THAN AMOUNT INDICATED**

Chapter 1

FERROCEMENT AS AN APPROPRIATE TECHNOLOGY

1.

INTRODUCTION

The roof tanks, toilets and spring reservoirs described in this monograph all are constructed from ferrocement. Ferrocement is defined by the International Ferrocement Information Centre as "a highly versatile form of reinforced mortar in which closely spaced and evenly distributed wire mesh reinforcement is impregnated with a rich cement-sand mix. This technique allows for fabrication of complex shapes as thin as 1 cm, even without the use of formwork. It has a high strength to weight ratio when compared to reinforced concrete, requires little or no maintenance when compared to metal structures and is more durable than asbestos."[1]

The versatility of ferrocement is seen in its following uses for Third World contexts : low cost housing; roofing; fishing boats; grain storage bins; irrigation canals; fish pond lining; septic tanks; and the water tanks and toilets discussed in the following chapters. Once the technique has been mastered different small-scale applications present themselves to the imaginative builder.

Other advantages in addition to versatility include the following: the readily available materials used; construction requires a labour intensive, simple skill; durability; non-corrosive; economical compared to nearest alternatives. By using mesh for reinforcing, ferrocement is more flexible than steel rod reinforced concrete. Other technical advantages can be obtained from the publications listed in the bibliography.

World wide interest in the use of ferrocement in under-developed countries was symbolised in 1976 by the founding of the International Ferrocement Information Centre in Bangkok as a result of recommendations made by the United States National Academy of Science's Advisory Committee on Technology Innovation. The Valley Trust in advocating the use of ferrocement, believes that more use could be made of the same in Southern Africa for a variety of applications. Technical guidelines are drawn from I.F.I.C. publications.

2.

Materials

The cement used is ordinary Portland cement type 1 or 2. Old stock affected by moisture should be avoided.

The sand is a medium coarse grade free from organic impurities. Large pieces of grit or wood will affect the walls of the tank adversely.

The water should be fit for drinking. Muddy water or water with other impurities should be avoided.

Several types of wire mesh can be used so long as it is easily handled and flexible. Chicken wire, in other words, hexagon mesh with apertures of 20mm. width is used locally. Hooping wire which is wrapped around the chicken mesh is guage 12. Soft tying wire is also used but pieces of wire cut from the mesh can also be used. Brick force is also used to reinforce the slabs. Any cut-offs are also employed so long as they, like all the wire, are rust free. It is interesting to note that bamboo is widely used as reinforcement in Asia.

3.

Mixing

Before beginning to mix make sure that all materials are ready on site. Mixing should take place on a metal tray or on a thin concrete slab. Any grit, twigs or similar, will weaken the eventual structure. Mixes should be done in batches and applied within one hour of mixing. The mixture should be well turned to avoid the occurrence of dry pockets of cement or air pockets in the mixture. There is a tendency to add more water to the mix while plastering is under way as the mixture dries and becomes less workable. This increases the ratio of water and also weakens the final structure. If possible the mixture should be shaded and covered by a plastic sheet if there is a delay in construction.

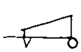
MIXTURES

		Cement	Sand	Stone	Water
TANK	CONCRETE Base Slab	1 Bag + 1 Bucket	15 Buckets coarse	7½ Buckets	5 Buckets
	Roof Slab	1 Bag	12 Buckets coarse	5 Buckets	3½ Buckets
	PLASTER First Coat	1 Bag + 2 Buckets	15 Buckets fine	—	4 Buckets
	Second/Third	1 Bag	12 Buckets fine	—	3½ Buckets
	Fourth (inside) Coat	1 Bag + 2 Buckets	15 Buckets fine	—	4 Buckets
	Sealing Joins, etc.	2 Buckets	5 Buckets fine	—	1½ Buckets
TOILET	CONCRETE Base Slab	4 Buckets	10 Buckets coarse	5 Buckets	4 Buckets
	Roof Slab	3 Buckets	7 Buckets Coarse	4 Buckets	3½ Buckets
	PLASTER First Coat	1 Bag + 1 Bucket	14 Buckets fine	—	3 Buckets
	Second Coat	1 Bag	12 Buckets fine	—	3 Buckets
	Slurry finish on inside wall	3 Milk cartons	5 Milk cartons fine	—	2-3 Cartons
	Pedestal : First/Second Coat	1½ milk cartons	3 milk cartons fine	—	1 Carton
	Ventpipe : Plaster	1 Bucket	3 Buckets fine	—	¾ Bucket
	Sealing joins, etc.	½ Bucket	1 Bucket fine	—	¼ Bucket

NOTES

 = 1 milk carton/plastic bottle which contains 1 litre

 = 1 builder's bucket which contains 10 litres (check yours!)

 = 1 builder's wheelbarrow which contains 5 builder's buckets (check yours!)

 = 1 bag cement contained in 4,3 builder's buckets.

"Coarse sand" means "Umngeni sand"
"Fine sand" means "Plaster sand"
"Stone" means "35mm. diameter aggregate"

Of vital importance is the correct proportion of sand to water to cement. Specific local usage is listed in Table 1. As a general rule the ratio of cement to sand by volume is 1:3. The ratio of water to the sand/cement mixture by weight is ½:1. Standard size containers are used to ensure a correct mix as the two concepts, ratio by weight and volume, are difficult to grasp.

4.

Curing

Cement gains in strength if it cures slowly. In rural areas without an abundant source of water to wet a ferrocement structure frequently it is difficult to cure properly. The concept, furthermore, is difficult to convey since most builders have had more or less satisfactory experience using concrete before and without a demonstration it is difficult to show the advantages in curing.

The Valley Trust has no set method. Wet hessian and plastic sheeting are both employed but the former dries quickly in windy and sunny conditions and the latter is expensive. Water should be let into a roof tank or spring reservoir tank as soon as possible to assist the curing at the base which is vulnerable to cracking. Slabs are cured for one week before moving. In general the curing will continue for at least fourteen days.

5.

Repairs

Hairline cracks, pin-hole leaks and weeping on the sides of tanks can be repaired on the inside by the application of a water resistant paint. This is expensive, however, and these minor faults can be corrected by increasing their aperture with a wire brush and filling in a 1:1 cement/sand paste.

Larger cracking is repaired by chipping off the plaster round the fault. More mesh is applied, plastered and left for five days. Emphasis on correct mixing and curing will prevent the necessity of such repairs.

1. Pama 1980

Chapter 2

THE VALLEY TRUST TRIPLE PURPOSE MOULD

This mould is used to build a roof tank, a spring protection reservoir and the superstructure of the ventilated, improved pit toilet. It is constructed by bolting together curved sheets of corrugated galvanised iron into six vertical sections. These vertical sections are bolted together in turn to form either a circular mould, for roof tanks and spring protection reservoirs, or a spiral mould, for toilet superstructures. In the latter case, one of the broad vertical sections is removed, the bolts joining the remaining sections one to another are loosened, and the remaining five sections are bent inwards into the illustrated spiral shape.

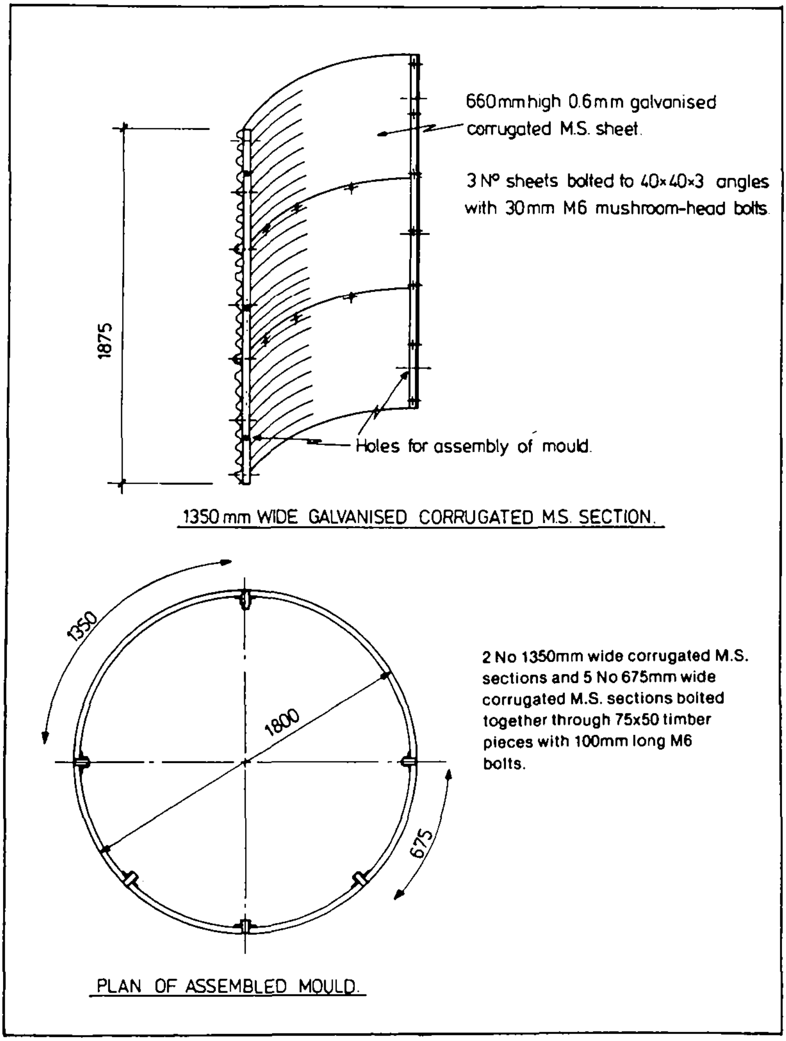


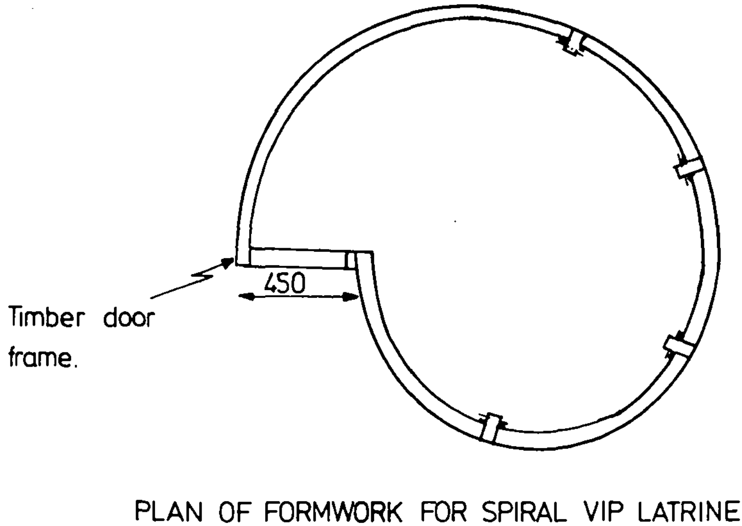
Figure 1: **DIMENSIONS OF MOULD**

Earlier attempts to use a mould comprising two vertical sections were not successful. Apart from the fact that this mould could not be used for toilets, great difficulty was experienced, firstly, in removing such a comparatively large piece of formwork from off the inside of the first layers of plaster. Secondly, passing the half section of mould up and over the sides of the tank or reservoir was difficult and threatened the comparatively fragile first layers of plaster.

To stabilize the circular mould during plastering, horizontal struts are bolted onto brackets attached to the vertical lengths of timber between the vertical sections of corrugated iron. It is more difficult, however, to stabilize the spiral mould. This can be achieved by temporarily wiring together points A and B in Figure 2, at the base and top of the mould. This also assists in stabilizing the timber door frame during plastering. This door frame is not essential but can be used by the toilet owner to hang a half-door or a gate as an improvement.

Local experience suggests that householders are keen on such improvements. The improved toilet is, firstly, frequently used as a wash-house requiring increased privacy. Householders also sometimes request some kind of door to prevent strangers from using the toilet and goats from sheltering there. The door or gate should not impede the passage of air down the pedestal and up the vent pipe.

The mould is not maintenance free. After each usage care should be taken to rub down the outer surfaces with a hard brush and rag to remove the residual grains of the plaster. These surfaces should then be lightly oiled with SAE 30 or similar. Without this maintenance the outer surfaces become rough and increasingly difficult to detach from the plaster.



PLAN OF FORMWORK FOR SPIRAL VIP LATRINE.

Figure 2

The advantages of this triple-purpose mould are self-evident. It is relatively cheap, built from standard size, generally available materials and can be disassembled and transported in the back of a small truck. It enables a rural dweller to apply one skill, that is the use of ferrocement, to three activities that are fundamental to rural development. A major disadvantage of ferrocement is the uneconomic delay between the application of the different layers of plaster. This can be shortened both by improved plastering techniques and by the use of two or three moulds used concurrently at different building sites.

Two sets of moulds, including the vent pipe and pedestal moulds described below, a set of the necessary tools (listed in the appendix) come to 1985 Rands 800 or $ 380. Since the work requires two men, this represents job creation at an extremely low capital equipment input cost, transport excluded. As in so many instances of rural development, however, the simplicity or excellence of a proposed technology must be seen in the full human context of its use.

Figure 3 A mould in circular shape to build a water-tank. The hooping wire is bound over the chicken mesh. A plastic strip prevents plaster entering the joints between sections of the mould. Light oil is rubbed over a used, cleaned mould to prevent plaster sticking. The thickness of the plaster is visible in the bottom part of this demonstration model at The Valley Trust.

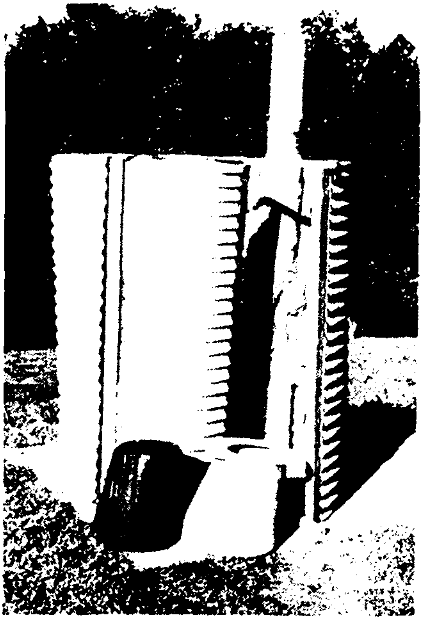


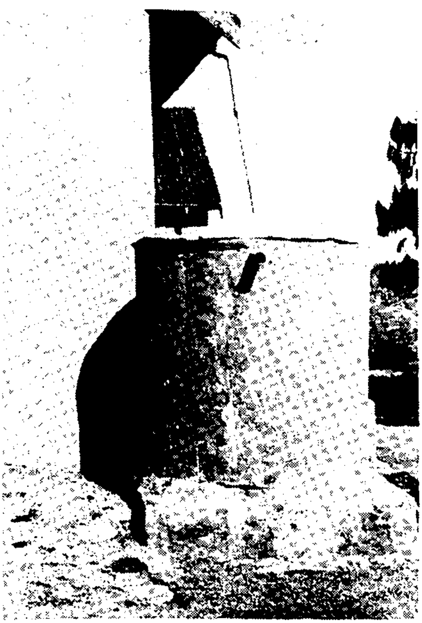
Figure 4 A mould in spiral shape to build an improved toilet. Also visible is the vent-pipe mould, the pedestal mould and a completed pedestal with the seat wired on firmly.

Chapter 3

THE FERROCEMENT ROOF TANK

1.

Recent research by The Valley Trust shows that the average consumption of water in the adjacent valley is 10 litres per day.[1] In households where the consumption is slightly higher, at 13 litres per head per day, there is a small but significant decrease in the incidence of certain infectious diseases, such as gastro-enteritis. While it is wrong to extrapolate further from these results, and while 50 litres per head per day is the World Health Organisation's minimum standard, the medical case for projects that slightly increase the availability of potable water is strengthened. The building of roof tanks should not be tackled in isolation, however, if an holistic philosophy is adopted. A variety of projects, such as spring protections, boreholes, pipelines, pumps and wells should be considered and choices made in terms of the terrain, supply, the economic and management resources and so on. Useful methodologies are set out in numerous publications.[2]



A second advantage of the ferrocement tank is its durability. According to Watt[3], if properly made, its life expectancy is over 50 years, which compares well with the 5 - 10 years expected of a galvanised iron tank. If we assume a roof collection area of 5 x 3 = 15 m^2 and an annual rainfall of 850 mm. then ideally, the water system yields 12,75m^3 per year. As rainfall is sporadic, and as a single tank's capacity is small compared to the roof collection volume, much rain is lost to overflow. If we conservately assume a consumption of 6m^3 a year this gives 300m^3 over 50 years. In 1985 figures, the cost of the tank, base and 5 metres of plastic guttering comes to R275. (US$ 165). Over 50 years this yields water at ,0036 South African cents/litre, (US$,0006 cents/litre) compared to the current piped water cost of R0,086 cents/litre. A full cost/benefit analysis is beyond the scope of this monograph but the fact that the tank can also be used to create employment should also be borne in mind.

The proximity of the tank, in contrast to alternative sources of water supply in rural and peri-urban areas is noteworthy and local inhabitants comment favourably on the coolness of the water. Although work remains to be done on the quality of tank water[4] there is no evidence to suggest that it is a significant source of pathogens. With the increasing prevalence of straight-edged corrugated iron roofs in rural areas there is obviously a strong case for the wider promotion of roof tanks by government and private agencies.

Figure1 A roof tank next to a church. The cracks are signs of poor workmanship in mixing and applying plaster.

OUTLINE OF CONSTRUCTION

2.

Before the decision to build a tank is made, a careful examination of the site is made. The base should be built on cut not fill. The rafters should be able to carry the fascia board and/or gutters. This frequently presents difficulties as the ends of the rafters do not always protrude past the roof edge and are not always in horizontal line.

Before construction begins all materials and tools should be gathered on site. Recommended materials and tools are listed in Tables 1 and 2. In practice it is always possible to improvise but where there is a skill shortage and since the capital cost of job creation is in this instance extremely low, shortcuts in materials or tools lead to unnecessary complications. A copy of the materials list can be lodged with the supplier to standardise deliveries. Tools can be checked regularly against a copy of the tool list as a control.

TABLE 1

LIST OF TOOLS FOR TANK/TOILET BUILDING

1 Pick
1 Rubber Bucket : 10 litres.
2 Pointing Trowels
2 Wooden floats
1 x 2 kg. Hammer
1 Shifting spanner
1 Wood saw
1 Spirit level
1 x 1 m. Crowbar
1 tin snip
1 Whitewash Brush
I Step ladder at 1,8 m. long
1 Tool Box
2 Spades
2 Trowels
2 Steel floats
1 Wheelbarrow
1 x 5 kg. Sledge hammer
1 Pair of Pliers
1 Hack saw
1 Screw driver
1 Cold Chisel ½"
1 Plastering Hawk
2 Padlocks
1 x 3 m. measure tapes
1 Wood Saw
1 Builder's Wheelbarrow (50 litres)

The lid of the tank is constructed first since it must cure for at least a week before being lifted. If the lid is moved before this, or if the amount of wire reinforcing is reduced, cracking is likely to occur. A site is levelled and inside the circular template a dome shaped pile of sand rising to an apex of 160 mm is made. This dome shape contributes to the strength of the lid and any tendency to flatten the shape or reduce the height at the apex should be avoided.

Plastic bags or sheeting is then placed over the sand and reinforcing wire. The wire is supported approximately 7 mm above the plastic by small stones or chips of wood. A smaller circular template is placed in the centre for the inspection eye and two straight pieces of soft iron on either side to divide the lid in two lateral sections.

Cement is then prepared as set out in Chapter 1 and placed over the wire to a depth of approximately 50 mm and left to cure, covered by plastic or a layer of sand to prevent the rapid evaporation of water which weakens the concrete. The lid is heavy and difficult to place over the tank. Cast in two sections, it is structurally stronger and easier to move. Some organisations make the lid in three or four lateral sections. In moving a section care should be taken that enough people are present to raise it without undue difficulty. Those lifting should position themselves at regular intervals round its edge. At no time should the full weight of the section be rested on a single point or edge.

TABLE 2

LIST OF MATERIALS FOR A TANK

8 pockets Cement
1200 x 25mm. Wire netting (14m. long)
500 g. Binding Wire
1 m^3 Umgeni Sand (Medium Course)
1 m^3 Plaster Sand (Fine)
½ m^3 Concrete Stone
1 x 15 mm. Gal. Socket
1 x 15 mm. Tank Tap
1 x Tap Lock Cover
2 rolls of 6" Brick Force
10 kg. Plain Wire (12 guage)
3 m. long of 15 mm. Gal. Pipe
5 m. of Plastic Sheeting
18 Ash blocks

The team then constructs the base. The site is levelled and ash blocks built into a square as per Figure 2. In some instances, where there is marked fall in the ground level, it is possible to do without blocks but this should only be undertaken by an experienced team. A 50mm reinforced layer of concrete is then built over the base, incorporating the pipe and a shallow depression or sump for easy cleaning. Care should be taken in the reinforcement and curing of this foundation as the mass of a full tank can cause cracks and leaking. Ensure that the tap is either at a short distance from the tank or set securely into the foundation.

The clean oiled tank mould is then erected on the base and plastic strips placed over the vertical joints. The chicken wire is placed round the mould and then the hooping wire is bound round firmly following the line of the corrugations. Unreinforced concrete is strong under compression but weak under tensile loading. Although the concrete in the tank is assumed to contribute some tensile strength, most of the horizontal stresses are taken by the hooping wire. Where these stresses are strongest, at the base and the top, an extra hooping wire is recommended, in the bottom 8 corrugations and in the top 2.

It follows that the joint between the foot of the wall is also vulnerable to stress and in practice most serious leaks due to poor construction occur here. Chicken wire should be bent back under the foot of the mould to provide reinforcing.

The first external layer of plaster is then applied, using the method described in Chapter 1, followed by the second and third layer. It is worth emphasizing again the importance of retaining the correct water : cement/sand ratio. The tendency, as stated above, is for extra water to be added to the mix (daga) as the work progresses and the mix stiffens. This weakens the concrete. A second tendency is to skimp on smoothing off by the wooden float. This action in effect compacts the layer of plaster further and helps to lessen the hairline cracks and tiny pockets of air in the layer as it settles and droops. The three layers should be in all 25 - 40 mm thick and covered with plastic sheeting to cure.

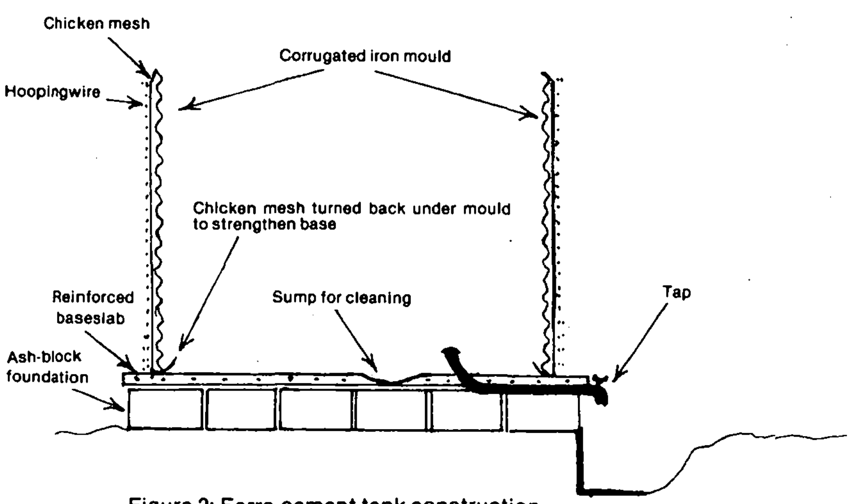


Figure 2: Ferro-cement tank construction

After at least 24 hours the mould is unbolted and handed carefully over the wall. Holes are cut for overflow and inflow pipes and the wall plastered from the inside, care being taken to thicken the layer at the joint between the wall and foundation to 5 cm. A second inside layer of plaster is recommended if the mix or workmanship is under question. If possible 5 cm of water should be left to stand in the bottom to ensure the proper curing of the joint.

Some teams are able to apply two layers of plaster in a day. There are, inevitably, delays in this construction process, however, and these should be used to complete the guttering. When the lid has cured it is placed over the tank and the joints sealed with cement. Some form of weeping normally occurs in the walls of tanks built by inexperienced builders but if slight this usually seals itself. The taste of the water after the tank is first filled is normally bitter, due to the presence of some minerals dissolved out of the wall. This soon disappears.

1. Friedman 1981
2. Kalbermatten et al 1980
3. Watt 1978
4. The Valley Trust is about to conduct a survey with N.I.W.I..

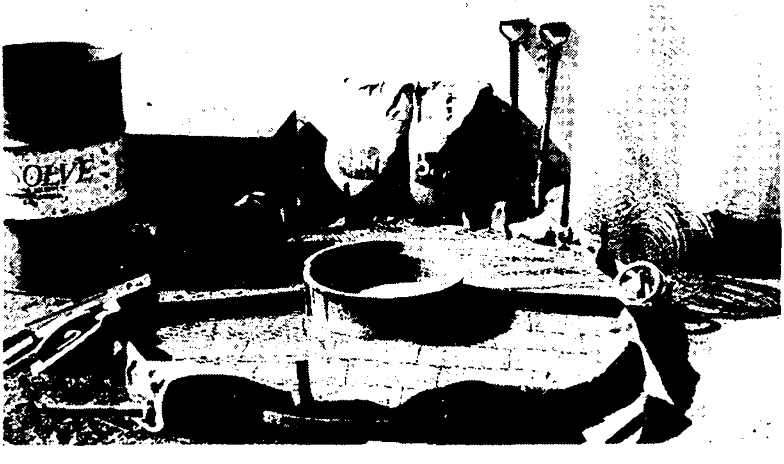


Figure 3: Preparing to cast the roof slab, clockwise from left, tools, barrel of clean water, tool chest with lock, cement, spades, chicken mesh, brick force and tying wire. The mould for the inspection eye is made from an off-cut of the black rubber rubbish bin used to construct the pedestal mould. Note the circular and horizontal templates.

Chapter 4

SPRING PROTECTION

1.

Spring protection is a well established technique . In The Valley Trust method, the eye is cleared, a filter and retaining wall is built and the flow piped to a reservoir tank. Water which would otherwise trickle away unused is thus stored for collection. A Water Association is formed prior to construction and a Committee and Maintenance Officer elected. A successful spring protection, therefore, should create a democratic structure for further development projects and should improve the quality and quantity of locally available water.

It is difficult to systematize the method because of the complex variety of springs and communities encountered in practice. Even in the relatively small area in which The Valley Trust team has protected 30 springs, this has been the case. Practical experience and a grasp of principles is emphased over the rote learning of a set of detailed technical instructions.

2.

Springs form when rainwater, permeating through the soil on higher ground meets a stratum of impermeable rock which conducts the water downward. An eye is formed when the layer of rock meets the surface or when the water table is higher than a porous part of the surface. If the higher ground is overgrazed or eroded, rainwater is less likely to permeate. A spring protection thus provides an opportunity to discuss the ecology of the area.

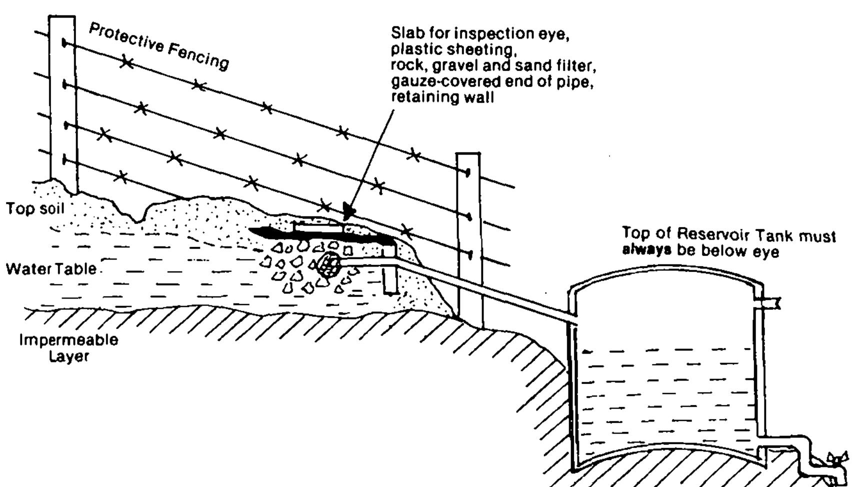


Figure 1: Spring Protection from the side

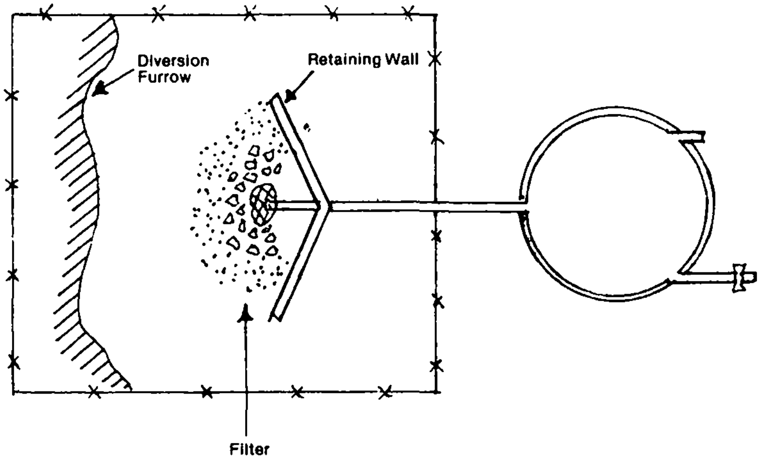


Figure 2: Spring protection from the top

Springs should be distinguished from a range of subsurface water supplies such as moist patches in small valleys and marshy ground. Although sometimes visible on the surface of a slope these are probably better suited to shallow tube wells, slow sand filters and other methods of collection. In some instances, using a longer retaining wall, the spring protection method may work.

A spring protection does not dam up the water issuing from the eye. If this occurs it is likely that the rate of flow will be reduced or stopped. In the latter case the water may flow more forcefully from another eye. The principle is rather that the water is allowed to flow downwards through the filter and then again down a slope to the reservoir tank. Damming up in the case of springs is equivalent to damming back and this principle should be thoroughly grasped.

3.

To prevent rousing the expectations of the community unduly, a technical assessment of a potential spring protection is made. A potential spring should run through the dry season, should flow at a rate of at least one litre a minute and should have a slope steep enough to accommodate a reservoir tank below the level of the eye within a short distance. No toilets should be upstream of the spring closer than 50 to 100 metres.

A prior assessment of the community's size and attitude towards a possible spring protection is also necessary. Again no hard and fast rules are possible and the survey form is included as a guide. The technical and social feasability of each potential spring protection must be considered on its own merits.

PRELIMINARY SURVEY OF NATURAL SPRINGS

A. GENERAL

DATE TIME NO.

VISITED BY :

DESCRIPTION OF THE LOCATION OF THE SPRING

GRID REFERENCE ON AREA MAP

B. TECHNICAL DETAILS

(a) Distance from Valley Trust (km)
(b) Distance from the nearest road (metres)
(c) Terrain

VERY STEEP	MODERATE	MID SLOPE	FLAT

(d) Is access to spring good for spring construction?
(e) What is your estimate of the yield in litres per minute?
(f) Is there adequate slope and room for a reservoir?
(g) Can a V-box or retaining wall feasibly be constructed?
(h) Are there other advantages from a technical point of view in siting a Spring Protection at this site?
(i) Are there disadvantages siting a protected spring at this point?
(j) Can the catchment area above the spring be fenced off?
(k) Are there toilets above the spring?
If so please put down each one and its distance
(l) Is there a drum or other improvement?
(m) Has the spring ever dried up?
(n) Is there more than one spring in the same valley or within 500 m?

C. SOCIAL DETAILS

(a) About how many households can you count in the vicinity of the spring who may use its water supply if it is protected?
(b) About how many households do you estimate use the spring now?
(c) What use is made of the spring?
   (i) Drinking water
   (ii) Washing clothes
   (iii) Gardening.
(d) Where do people do their washing?
(e) Does the washing water contaminate the spring?
(f) Does the spring look

VERY CONTAMINATED	DIRTY	FAIR GOOD

(g) Do people use any other water for drinking or domestic purposes? If so, what?
(h) What is your impression of how nearby people feel about improving the spring?

VERY KEEN	FAIRLY KEEN	UNDECIDED	RELUCTANT	AGAINST IT

(i) Has any improvement ever been attempted at the spring? What?
(j) Is there a committee already operating at the spring?
(k) If so list the number of households who are members and have agreed to the protection.

GENERAL COMMENTS

TABLE 1: *Example of a brief,* preliminary survey of the Community and site of a potential spring protection.

The trench from the V-box to the reservoir is dug with as steady a fall as is possible and the pipe laid. The reservoir tank is then built. A scour valve is placed as per the diagram to wash out the grit that accumulates over time. The valve is made from a T piece with a stopper. Ensure that the pipe running up the side of the reservoir is well protected and that the tap is led to a secure site a few metres from the tank. The overflow should fall on a small slab to prevent eroding the soil on one side of the tank. The trench is back filled and also any sharp incline at the reservoir site. Ensure that the Maintenance Officer knows the position of the inspection eye, the trench and the scour valve. A steady overflow can be led through a pipe to a cattle trough or concrete washing basin nearby.

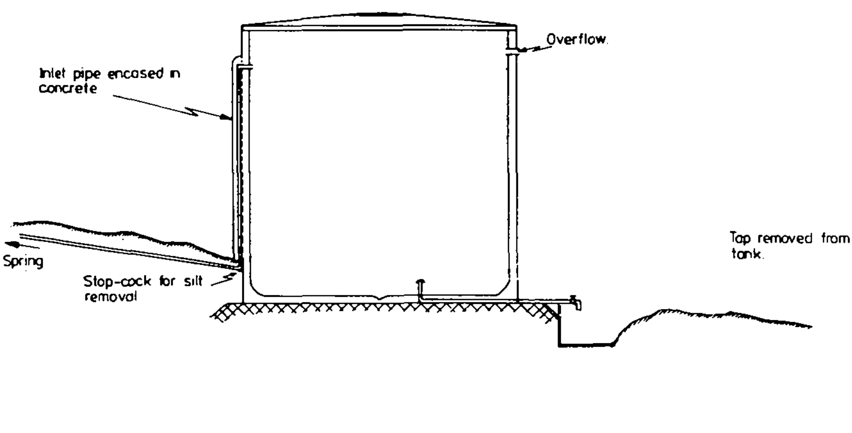
Practical training of a spring protection team consists not only in construction techniques but in planning the work step by step before commencing. Emphasis is made on a weekly plan setting out each step and a daily record in which work completed is written up. This improves the chance of the cost effective use of transport. The liaison personnel should complete the preparatory work for three springs ahead of the construction team so that the latter can work without long delays. As with many development projects it takes several months before teams become conversant with the requirements of the work. A sketch is made of each spring protection for reference in the future and spring protections planned using a map of the area on which prospective spring sites and completed springs are identified. An evaluation form is supplied for convenience in follow-up.

Figure 5: A spring protection reservoir tank with the tap downhill to the right

The site for the reservoir tank is confirmed ensuring that its top is obviously lower than the eye of the spring. Its base is constructed on cut using a reinforced slab and not necessarily a foundation of ash blocks as described in Chapter 3. The roof is also made and both foundation and roof slabs are left to cure.

Construction continues at the eye. The V shaped wall is built using planks for form work and leaving a hole at its apex in which the black PVC piping, diameter 25 mm, is placed to lead the water away. The V-box is then filled with clean stones, gravel and clean sand which further filters the water in addition to the gauze placed over the mouth of the pipe. This tends to muddy the water initially and the spring should be left to run until it clears. Black plastic sheeting is then placed over the V-box and a square slab approximately 60 cms by 50 cms is placed over a square aperture in the sheeting and over the end of the pipe for easy access if the filter is to be cleaned. The sheeting which prevents polution from surface water is then covered with a layer of sand and soil with a diversion furrow dug above the V-box to divert any erosive surface water. The V-box area is then fenced off to preserve the vegetation and to prevent pollution by cattle and goats.

Figure 4: The Spring Reservoir



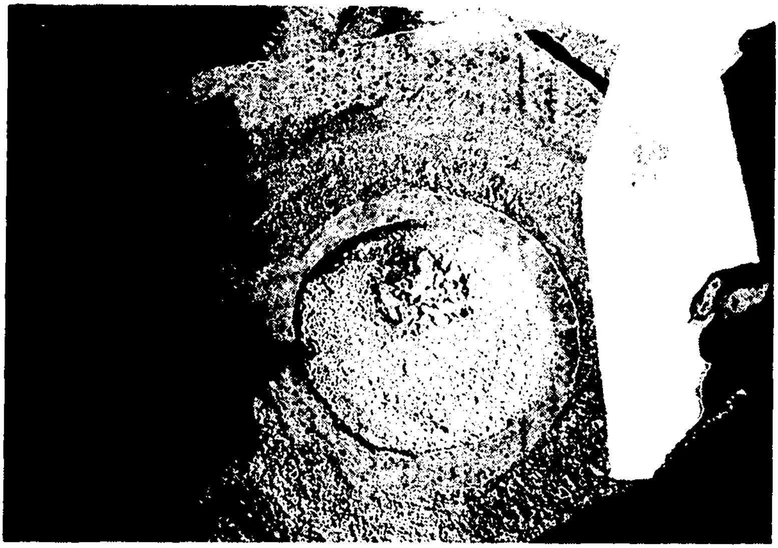


Figure 3: Retaining wall or V-Box at eye of a spring. The sand filter here includes a concrete ring with holes round the sides in which the pipe-end with a piece of gauze draws off the water through the apex of the V-Box. The slab is the cover of the inspection eye.

4. Construction

Before commencing the spring protection ensure that all the community liason work has been completed, a Water Association formed a Committee elected and a Maintenance Officer appointed, who must be present throughout construction. Do not begin work until the Maintenance Officer is present, otherwise he will not know what is under the V-box. Do not begin work until the community have piled on site the stones and/or sand agreed upon as their contribution in labour. Since the Committee has a new Constitution it is likely to move more slowly than the organisation doing the actual construction and the tendency is to take over the community's responsibility when it is not immediately forthcoming. If this is done you will make the community perceive the spring as your protection and you will become responsible for its maintenance in their eyes. The Committee's potential authority has also been weakened.

Once all the above conditions have been met construction can begin. The soil around the eye is cleared until the spring flows cleanly from the sub soil, mid soil or from among rocks. At this point a temporary earth wall is made and the water led through a pipeline to a temporary reservoir made from a plastic or metal drum. This measure also involves the community in the construction as observers and is a chance for the team to discuss the project with the community. The community should not be driven to distant springs during the course of construction.

Figure 6: Spring protection in the crowded peri-urban area of Embo. The reservoir tank is just visible in the middle

		Before		After	
Tech. Number	Name	Coliform orgs. per 100 ml.	Faecal E coli per 100 ml.	coliform orgs. per 100 ml.	Faecal E. coli per 100 ml.
TS 223	Mabedlane	180 000	500	2 500	200
TS 226	Silindokuhle No. 1	1 300	Nil	110	Nil
TS 227	do. No. 2	800	70	80	Nil
TS 241	Nhlabamasoka	800	20	50	Nil
TS 283	Zamani	110	20	Nil	Nil
TS 267	Mhqumo No. 2	7 000	3 500	110	Nil
TS 300	Mhqumo No. 3	70	Nil	Nil	Nil

TABLE 3. Improvement to water-quality at protected springs. Coliforms and E.Coli are indicators of pollution. The World Health Organisation's suggested standard for the prevalence of faecal E.Coli is a maximum of 50 per 100 ml on one of three successive tests. Analysis through State Health.

Table 2: SPRING EVALUATION

Name of Evaluator: ....

Time and Date of on-site Evaluation: ....

Name of Spring: .... Technical Number ....

Name of Maintenance Officer: .... Signature ....

1. Fence around eye [No Problems | Needs Repair]

2. Soil above V-box [Bushy | Grassy | Clear | Needs Clearing]

3. Sand in filter [Clean | Dirty]

4. Any sign of water leakage near the V-box? [Yes | No]

   If Yes, describe ....

5. Any problems along the trench or Pipeline? [Yes | No]

   If Yes, describe ....

6. Describe what came out of the pipe when you opened the flush valve ....

   ....

   ....

7. How often has the Maintenance Officer opened the flush valve? ....

8. Does he have any problems with the flush valve? [Yes | No]

   If Yes, describe ....

   ....

9. Any water leakages where the pipe goes into the Reservoir Tank? [Yes | No]

10. Is the concrete sleeve round the pipe at the side of the tank still alright? [Yes | No]

    If No, describe the problem ....

....

11. Is there any sign of soil erosion or damage near the tank? [Yes | No]

    If Yes, describe how far away ....

12. Is the Maintenance Officer prepared to stop this soil erosion or damage causing a problem to the tank? [Yes | No]

    If Yes, by when will he finish? ....

    If No, what will he do about the problem? ....

Table 2: SPRING EVALUATION (Cont.)

13. Are there any leakages around the tank? | Yes | No |

If Yes, describe where they are and how much they are leaking? ....

....

14. Is there a lock on the tap? | Yes | No |

If Yes, is the tap locked or unlocked? ....

15. Is the tap dripping or damaged? | Yes | No |

If Yes, what did you and the Maintenance Officer do about the problem? ....

....

16. Did you take a water sample for testing? | Yes | No |

If No, when will you do this? ....

If Yes, what was the result?

Date	E.Coli.	Coliforms

17. Was the soil around the side of the tank free from grass and trees that could harm the tank? | Yes | No |

If No, what will the Maintenance Officer do about the problem? ....

....

18. What colour was the water?

Brown	Light Brown	White	Red

19. How did the water taste?

Sweet	Bitter	Pleasant	Unpleasant

20. What problems has the Maintenance Officer had?

a. ....

b. ....

c. ....

21. What other problems at the spring protection do you see?

a. ....

b. ....

c. ....

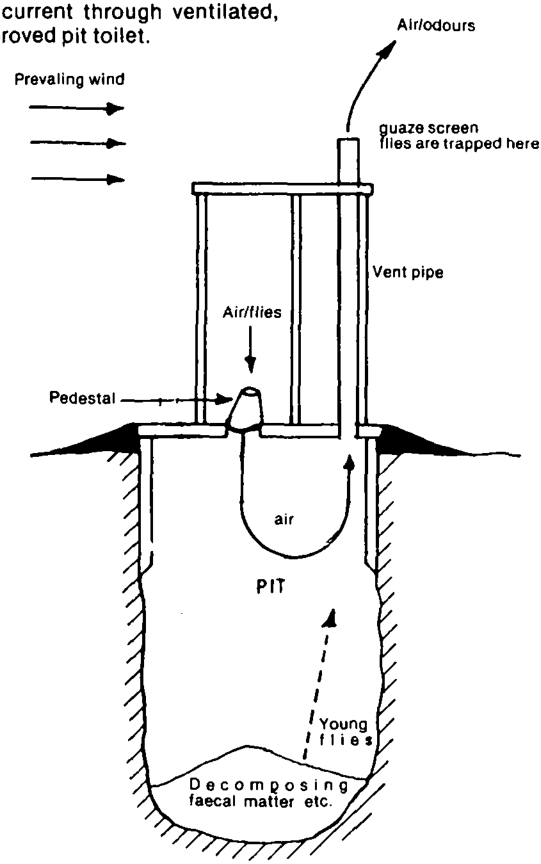
Chapter 5

THE IMPROVED PIT TOILET

1.

The Valley Trust promotes a modified version of the Blair Toilet. Attention is drawn to the series of excellent technical publications that describe this toilet and alternative designs in detail[1]. The principle behind the toilet is straightforward. Wind passing over the vent pipe draws out the air from the pit. Flies that breed in the pit or fly down there from outside escape towards the light at the top of the vent pipe where they are trapped by a piece of gauze. The toilet is thus virtually fly and odour free which is a pleasing alternative to most do-it-yourself toilets in poor rural areas, especially as flies are vectors in the transmission of faecal-oral diseases such as gastro-enteritis. The essential components are a solid slab, to seal the pit, and an efficient vent pipe. The design of the superstructure is much less important and a wide variety of materials can theoretically be used. Local preference has been for a spiral-shaped ferrocement superstructure. Experiment has shown there is little or no truth in the earlier assumption that the sun heating the north facing vent pipe warmed the air and this created the up-draught.[2] The Blair design is now generally known as the ventilated, improved pit toilet (V.I.P.)

Fig. 1 Air current through ventilated, improved pit toilet.



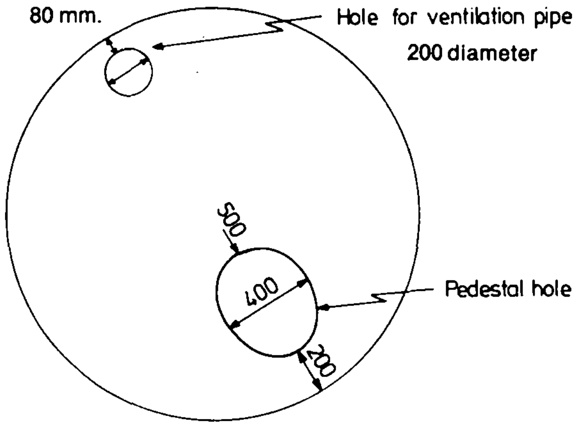


Figure 2: BASE SLAB FOR VIP LATRINE

2.

TOILET MOULDS AND TEMPLATES

In addition to the superstructure mould described in Chapter 2, a number of smaller moulds and templates are employed.

The vent pipe mould is a 2 metre length of plastic piping with a diameter of 200 mm. The ferrocement vents so constructed have been found to be sturdy and efficient but since the first of these constructed locally are only two years old it is still too early to make an assessment. Vent pipes can also be made from 2 metre lengths of PVC piping with a diameter of 110 mm although this adds to the construction cost.

Templates for the slab and roof can be improvised but this tends to produce irregular edges, a haphazard appearance and lessens the likelihood of the toilet's widespread acceptance. It is patronizing to promote the acceptance of an "alternative technology" if it is shoddier and less efficient than other, more expensive alternatives known to a purchaser, even if outside that person's price range. The relative simplicity of the technology is an advantage and not an excuse for poor quality of construction. The templates for the slab, base, pedestal hole and vent pipe hole are made from 5 - 7 cm wide strips of flat iron joined with M6 mushroom-head bolts.

The pedestal presents a particular problem. A vertical-sided pedestal in a waterless toilet is unhygienic and attracts flies for obvious reasons. A prototype using an asbestos pipe at Valley Trust confirms this assumption. A squat-plate is not acceptable. The pedestal should slope away backwards at the rear to prevent contamination. This can lead to an expensive plastic or polystyrene pedestal, as found in some commercial V.I.P. toilets. The Valley Trust employs ferrocement placed round a mould cut out from a black rubber rubbish bin. The backward rake of the mould is difficult to soil. The cost of the ferrocement pedestal is low at approximately 1985 Rands 10 US$ 4.

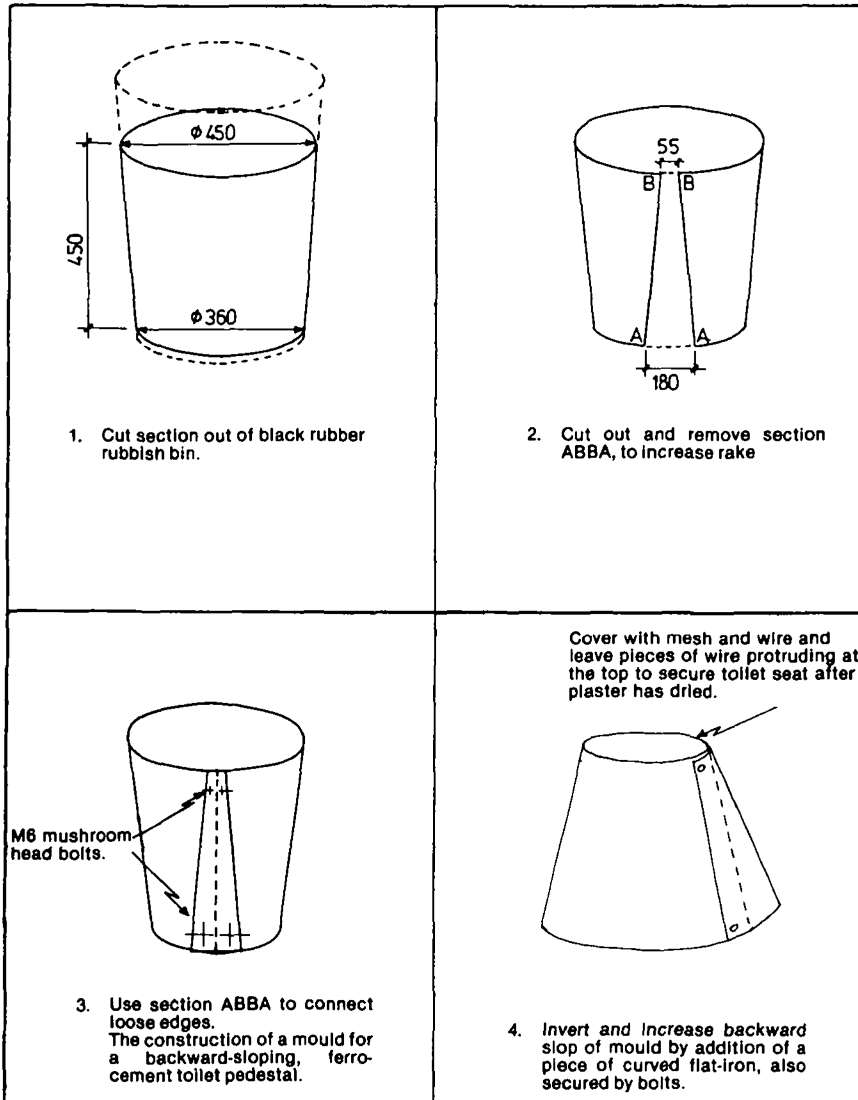


Figure 3: The construction of a mould for a backward-sloping ferrocement toilet pedestal.

3.

THE PIT

To mark out the pit site, the template for the base slab is used. The template is shortened to give a diameter of 1,5 metres and the pit is dug to a depth of at least 2,5 - 3 metres. The lifetime of a pit for a family of nine people is approximately eight years but this is only an estimate as pit-life also depends on soil types and a variety of other factors.[3].

The soils in the area where The Valley Trust works are generally stable and two creosoted poles of diameter 8 - 9 cm are placed across the pit to support the superstructure in case of soil erosion at the top edge of the pit. This method is inadequate in areas of looser, sandier soil. In such cases, a circular, reinforced concrete beam cast in situ round the top of the pit can be used. Alternatively, a brick or ash block collar can be built.

Soil type is a limiting factor in the installation of pit toilets, particularly where the water table is within two metres of the surface. Pathogens can travel long distances underground in the water table and attention is drawn to the various publications that describe techniques of lining the pit which take into account loose soils and a high water table[4]. It would be wrong to give the impression that the V.I.P. toilet here described is either universally applicable or of one design. The pit is best sited down wind of the user's home and if the ground slopes a V-shaped diversion furrow is dug on the top side. Surface water otherwise quickly erodes the edges of the pit and the superstructure tilts over.

4.

OUTLINE OF CONSTRUCTION

The general principles set out in Chapters 1 and 3 apply here. The base slab and roof are cast like the roof of the water tank with a circular template and on a shallow dome of sand. The base slab of the toilet, however, cannot be domed to the same height as water would run off and collect against the inside of the superstructure's wall. A flatter slab, using more reinforcement in the form of brick force is used. In addition to the holes for pedestal and ventpipe a small hole is made near the pedestal. Normally plugged with a piece of paper or similar, this is used to dispose of the water used to wash down the slab and pedestal. A small amount of water does not harm the biological process in the pit but householders should be warned against the excessive use of non-biodegradable soaps and cleaning fluids. As with spring protection, an opportunity for practical ecological education is presented. The small template for the ventpipe is placed in the case of the roof at the edge. It has been found easier to align the ventpipe with the roof by offsetting the latter by 8 centimetres to one side so that the

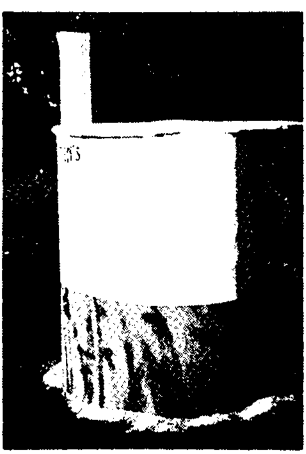


Figure 4: V.I.P. toilet from side showing (a) how roof slab is off-set to right over entrance, and (b) how vent-pipe goes through roof on the inside of the wall. The height of the vent reduces smell nearby.

TABLE 1: LIST OF MATERIALS FOR A TOILET

2 rolls of 6" Brick Force
4 pockets Cement
1200 x 25 mm. Wire Netting 14m. long
5 kg. Plain Wire
500 g. Binding Wire
½ m^3 Umgeni Sand
½ m^3 Plaster Sand
½ m^3 Stone
Mosquite Gauze
1 roll of Hessian
50 x 75 SAP rough timber 1,36 m.
2 x 7' 3-4 treated poles
1 packet Stapler Nails
1 cheap toilet seat

roof overhangs the entrance more and the ventpipe is cast through and not against the roof. (Fig. 4.)

After a week, when the base slab has cured, it is pulled across the two poles over the pit. The tank mould, with one of the broad vertical sections adjacent to a broader section removed, is then erected in a spiral configuration on the slab. The spiral is secured in position by the wooden door frame, or in its absence by wire across the top and bottom of the doorway. Chicken mesh, hooping wire and plaster is then applied. Only two layers of the latter are required, finished off on the inside with a wet plaster. To avoid rust, no reinforcing wire should be left uncovered. The roof is placed on top and after its position has been checked with the ventpipe mould, sealed into position with cement.

The pedestal can either be prefabricated or cast while waiting for the slabs to cure. The mesh and plain wire is bound round the mould. Small lengths of wire are left protruding above the mould. These are used to tie the toilet seat down to the pedestal, small holes having been drilled in the lugs beneath the seat. If properly constructed the pedestal walls need not be thicker than 15 - 20 millimetres, finished off if necessary on the inside with a smooth plaster. The pedestal is placed in position on the slab and sealed into position with concrete.

The ventpipe mould is then positioned, covered with hessian and chicken mesh and plastered to a thickness of 20 - 30 mm. The drag effect on the water flow passing up the pipe by the comparatively rough inside of the ferrocement pipe thus formed is compensated for by its relatively wide diameter. To increase the pipe's efficiency and distribute obnoxious odours effectively, the pipe should protrude at least 35 cm above the roof[5]. Mosquito gauze is placed over the top. A sun resistant variety is recommended to lengthen the maintenance free life of the fly trap. Bituseal or similar should be painted inside the superstructure up to knee height.

5.

GENERAL

The V.I.P. toilet can be improved with a variety of optional extras. A health sign and information poster about the toilet can be displayed. A simple gate can be hung in the doorway. Toilet paper, a towel and water for hand washing can be kept inside. Builders of the toilet can give health education to the recipients, describing the link between poor sanitation and various infectious diseases. In houses with crowded living conditions, people can use an improved toilet as a wash house. An example of an evaluation form is included to assist a long-term toilet building project. Although the V.I.P. suits individual homesteads, a series of toilets can be built to take the heavier demands of schools. The Valley Trust is currently investigating a double pit toilet with a ferrocement spiral superstructure as a more cost effective alternative for schools.

1. Kalbermatten et al 1980
2. Ryan and Mara TAG Technical Note 4
3 N.I.B.R.
4 Lewis 1980
5. Ryan and Mara, op. cit.

Figure 7: An unventilated pit toilet beside a V.I.P. Weather quickly affects unsheltered wooden doors.

Table 2: EVALUATION OF SANITATION PROJECT

Technical File No.: .... Name of applicant: ....

A. TECHNICAL

Hole dug by | Family | Contractor | Other (specify) |

....

Time taken in days
(start to finish) .... Cost of hole: R....................................

Hole was | Right size | Too wide | Too narrow | Too shallow | To deep |

Type of Topsoil | Hard | Loose | Depth of Topsoil: .... cm

Type of Subsoil: | Hard | Loose |

Soil at bottom of hole | Dry | Moist | Wet | Roots | No roots |

Distance of toilet from nearest spring/river .... m

Number of other toilets within 100 metres ....

Slab | Level | Tilted | With Plughole | No Plughole |

Diversion furrows for surface water | Present | Absent |

Rings in slab to pull toilet to new hole | Nil | 1 | 2 | 3 | 4 |

Pedestal | Satisfactory | Not Satisfactory |

If not, explain ....

Smell | Satisfactory | Not Satisfactory |

If not, explain ....

Flies inside | Yes | No |

If yes, say where ....

Walls | Satisfactory | Not Satisfactory |

If not, explain ....

Vent Pipe and Gauze | Satisfactory | Not Satisfactory |

If not, explain ....

Roof | Satisfactory | Not Satisfactory |

If not, explain ....

Table 2: EVALUATION OF SANITATION PROJECT (Cont.)

B. LIAISON

Opinion of senior member of household (specify which one, e.g. Mother): ....

Price at R175 per toilet (excluding hole)

High	Low	Acceptable

Smell

Nil	Some smell	Bad smell

Flies

Nil	Some flies	No flies

Is the lack of a door a problem?

Yes	No

If yes, describe the problem ....

....

Do the members of your family use this new toilet more often than the old toilet?

Yes	No	The same

Do you think the people who live near you would also like to buy this toilet?

Yes	No

If yes, how many

A few	Many	Most

What do you like most about this toilet? ....

....

....

What do you like least about this toilet? ....

....

....

C. HEALTH EDUCATION

Knowledge of Applicant

1. How do diseases in faeces spread?

Don't know	Water	Hands	Flies	Food	Other

....

2. Can you name some diseases that spread when urine and faeces are not contained in a toilet or there is poor hygiene?

Don't know	Typhoid	Cholera	Diarrhoea/Gastro-Enteritis	Jaundice

Dysentry (Bloody Diarrhoea)	Worms	Bilharzia	Other

....

Figure 5: Two V.I.P. toilets and a ferro-cement water-tank as part of the upgrading of a peri-urban creche. The toilets have small, specially made ferro-cement pedestals.

Figure 6: What happens if there is no diversion furrow round a toilet to divert surface water and if the slab is too small for the pit. Surface water can erode away the collar of the pit.

Chapter 6

PIPED WATER SUPPLIES

1.

Rapid urbanisation without a concomitant increase in services is a characteristic of development in many parts of the world. On the western fringe of Durban, where The Valley Trust concentrates its field work, a mixture of urban, peri-urban and rural characteristics is presently found. Improvements to the water supply of the latter two sections has taken the

OFFICIAL
STAMP

COUPON No. ....

VALUE =

Indicate with a cross — Invalid if more than one is crossed

A NUMBER IS CROSSED OFF FOR EACH 20 LITRE CONTAINER DRAWN

FULL MEMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
	31	32	33	34	35	36	37	38	39	40	41	42	43	44		
	45	46	47	48	49	50										
PARTLY PAID-UP MEMBER	1	2	3	4	5	C	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25							
NON MEMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20												
SPECIAL MEMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
	31	32	33	34	35	36	37	38	38	40	41	42	43	44		
	45	46	47	48	49	50	51	52	53	54	55	56	57	58		
	59	60	61	62	63	64	65	66	67	68	69	70	71	72		
	73	74	75	76	77	78	79	80	81	82	83	84	85	86		
	87	88	89	90	91	92	93	94	95	96	97	98	99	100		

Name of Household Head .... Membership No. ....

Amount received .... by whom .... Date: ....

Each coupon must be signed by an individual authorised to supply these coupons and is invalid unless stamped with the Tribal Authority Stamp

Table 1: WATER COUPON

form of the spring protections and ferrocement tanks described above. The bulk of the population, however, is concentrated near the road running northward along a ridge, and piped water supply projects have been designed to cope with the increased demand of closer settlement.

Although the major project in this regard is still in its infancy, a summary of its design and a description of a successful pilot project are included. Their presence emphasises The Valley Trust's holistic approach to development. No one water supply project can fit the different terrain, settlement pattern and financial resources of the area. A variety of different but complementary approaches are necessary, which must remain flexible to accommodate the *rapid changes under way.*

Much has already been written on the subject of piped water-supplies[1]. The problems associated with piped water supplies are numerous and include the high capital cost and difficulties in maintenance and administration. The obvious advantage is the improved proximity of cheaper, cleaner water to more people, although it has been shown that without health education this may not improve child mortality[2]. Indeed, the provision of better services in a peri-urban area may well be a further inducement for rural migration and subsequent unhealthy overcrowding informal settlement. The Valley Trust has taken the expressed need of the community for a piped water supply as an opportunity to fulfil that need together with a programme of health education and the development of the human infra-structure needed to maintain and administer the project locally.

PILOT PROJECT

2.

In answer to a request, The Valley Trust extended its own piped water supply to a standpipe beside the courthouse in adjacent MaQadini three years ago. Prior to this a Water Association was formed using a model constitution (see Appendix), a Committee elected and a coupon system of payment implemented. Members of the Association purchase a coupon from the Treasurer which entitles them to a number of 25 litre containers of water. The Committee employs a Water Bailiff to administer the supply at the standpipe. After initial record-keeping difficulties, the scheme has worked smoothly without defaulting payment. Well documented larger pipelines elsewhere in the Valley[3] and the likelihood of support from major donors such as World Vision the Development Bank of Southern Africa made a large pipeline project a possibility.

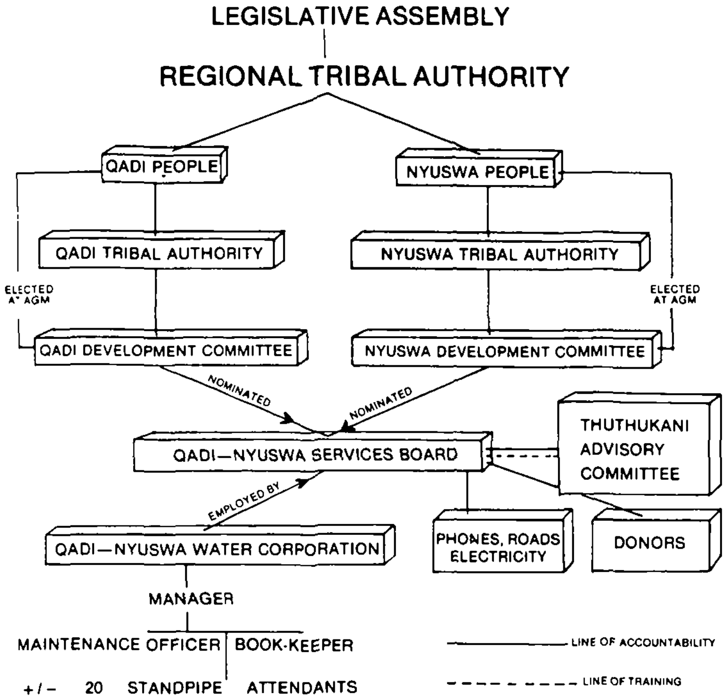
3.

QADI/NYUSWA PIPELINE

The project envisages a 12 km pipeline with approximately 30 standpipes supplying water to over 10 000 people. Design specifications have been set out, funds promised and the liaison and training work begun. Detailed reports will be made as the project progresses. At this stage mention will be made of two of the theoretical assumptions behind The Valley Trust's role in the project as a catalyst, trainer and monitor.

The first assumption concerns local *government. The two areas concerned,* Qadi and Nyuswa, are administered by their respective Tribal Authorities. As described in Chapter 6, they have approved the constitutions of the Qadi Development Committee, the Nyuswa Development Committee and the Qadi/Nyuswa Development Committee whose members are nominated from the two former committees and whose function is to deal with development issues, such as piped water and electricity, that affect both areas. The Development Committees are elected bodies, unlike the Tribal Authority whose councillors are appointed by the Chief. The latter system makes it extremely difficult for the community to control financial resources raised in the community. The assumption is that the Development Committee should administer the piped water supply and not the Tribal Authority. No opposition

QADI-NYUSWA PIPELINE : DRAFT ORGANISATIONAL STRUCTURE



to this assumption has been met thus far. The draft plan is included as a diagram for ease of reference.

The second assumption is that if the community is to own and administer the pipeline, both initial training and support training is necessary. By the former is meant training in supervisory skills, job interview techniques, bookkeeping and record keeping; by the latter a regular system of follow-up training visits, the monitoring of the bookkeeping and record keeping systems and the technical aspects of water supply.

Some popular writing on development in the Third World has taken the somewhat romantic view that more open-ended, "convivial" approaches are preferable[4]. While not taking issue with the valuable critiques of Western society such writing often provides, our experience at an interface of western and underdeveloped societies has been otherwise. The community expressed the need for developed technologies and a wish for the organisational development of the human infrastructure needed to reap its benefits. This does not imply, however, that the institutions that result will or should parallel their Western counterparts.

1. see TAG publications listed in Bibliography, White 1981, and Cairncross 1985
2. Merrick 1983
3. Rivett-Carnac 1984
4. see Illich and others

Chapter 7

1.
TRANSFER OF TECHNOLOGY

The Valley Trust philosophy emphasises self-help. The temptation to employ more technical staff and build tank and toilets in response to the community's requests for these has been resisted in preference for a system whereby the community itself administers such a project. Potential applicants are well aware of the high technology available nearby and therefore to avoid the provision of second class solutions stress has been made on the quality of the constructions, not always with success. Applicants express need for improved water and sanitation but do not have the cash to pay for such in toto. The transfer procedure, therefore, has a rotating fund, which has been used successfully by The Valley Trust to provide fencing for many years.

There are many different ways of transfer. These include the use of local builders, small businessmen, such as shop owners, local government, such as Tribal Authorities, Development Committee, or Government Extension Officers and church or school councils, all of which could provide the necessary supervision and control of the credit fund.

The Valley Trust works through locally elected Development Committees as part of a programme to develop local government and administrative skills.

2.
DEVELOPMENT COMMITTEES

KwaZulu is a constitutional monarchy with a Legislative Assembly. At local level, however, the inherited powers of Chiefs remain since Tribal Authorities comprise officials appointed by Chiefs and not elected. Tribal Authorities exercise a wide range of powers as defined in the relevant acts.

This system is often cumbersome. To enable skilled people to tackle every day development issues Development Committees were formed three years ago. Their Constitutions are approved by the Tribal Authority which retains the right of veto and dissolution at a mass meeting but does not involve itself in Development Committee functions. The Qadi and Nyuswa Development Committees comprise both Tribal Authority and skilled members of the community and have already busied themselves with development issues such as electricity, telephones, a piped water supply and the water and sanitation project.

This dual system of local government is still new and carries with it risks. The Development Committees however, function with the full support of the local Magistrate,Tribal Authorities and the KwaZulu Government and might function as a model for a reform of local government in KwaZulu in the future. Much work still remains to be done in this area. It should come as no surprise that the transfer of technology has led to an involvement with local government.

3.
IMPLEMENTATION

The Development Committee employs a two-man team trained at The Valley Trust in tank and toilet building. The Committee owns two moulds, the tools and administers the rotating credit fund.

Implementation is theoretically straight forward. A member of the community fills out an application form for a tank or toilet, pays a R50 deposit and in time the team completes the construction. The team is paid for this labour by the Committee. The community member pays back in instalments and a new application is accepted.

The scheme was started two years ago and involved the Development Committees in Qadi, Nyuswa and Embo. Approximately 40 tanks and 40 toilets have been built in this period. The main problems were administrative and it was decided to extend the work of The Valley Trust's Technical Officer to include extension work to follow-up in the field.

The main other problems were that the Development Committee selected ill or extremely unskilled trainees and did not have the time to supervise these. Lack of transport delayed construction. In retrospect this was not surprising as the Chairmen of the Development Committees who administer the project work as volunteers. Since the Technical Extension Officer is an innovation the cost effectiveness of the project needs to be tested. If not favourable another method will be tried. If successful, there is no theoretical reason why there should not be Technical Extension Officers employed by the government to promote water and sanitation in rural areas. These could be Agricultural Extension Officers with further training.

This project has given local Development Committees a role and experience in administration. Larger projects are now being tackled by these Committees and the concept is becoming established in the local communities.

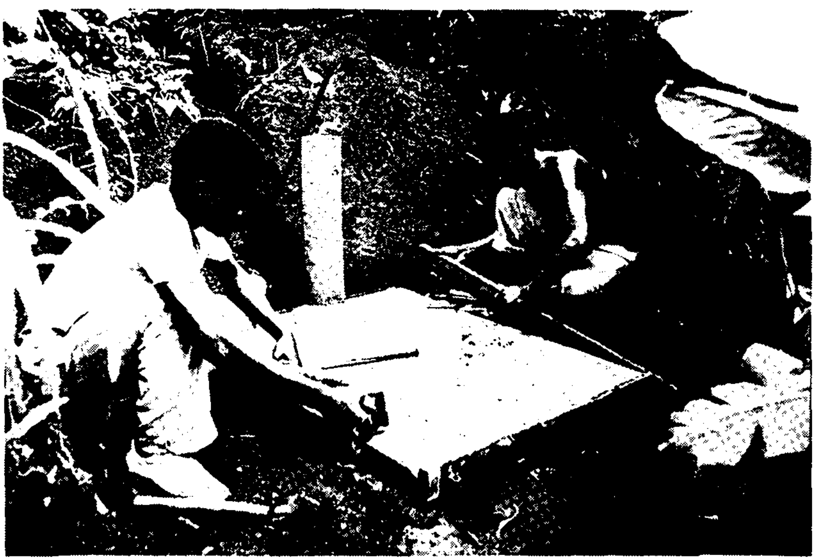


Figure 1: A good example of a spring protection tap and splash plate being constructed by trainees. The V-Box is approximately 12 metres away.

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*TN/11 Monitoring and Evaluation of Communication Support Activities in Low-cost Sanitation Projects; by Heli Perrett.

Appendix A

MODEL CONSTITUTION FOR A COMMUNITY (HEALTH) ASSOCIATION, e.g. WATER SUB-COMMITTEE

(Zulu version available on request to The Valley Trust
This constitution is a guide to be adopted as necessary)

1. NAME. The name of the Association shall be..........................

....

2. AREA OF OPERATION. The Association shall give services to the community in the following area(s):.................................

....

3. OBJECTS The aims and objectives of the organisation shall be:

....

....

....

4. MEMBERSHIP

4.1. Membership will be open to.............................. who are responsible to the............................... (Tribal Authority) through.. (Local Induna).

4.2 A Joining fee of R............. shall be paid by each new member. The *yearly membership fee shall be R............ and this fee shall be paid* by......................(date) each year.

5. MEETINGS

5.1. An ANNUAL GENERAL MEETINGS shall be held each year in the month of........................

5.2. A SPECIAL GENERAL MEETING may be called by any.........(number) members or by the COMMITTEE.

5.3 .... % of the members of the Association must be present for the meeting to be proper or at least............ paid up members are a quorum.

5.4 Notice of the meeting will be drawn to the attention of the members in the following way: ....

....

5.7 .... % of members of the Association must be present for the meeting to be proper or at least......... paid up members are a quorum

5.8 Each paid up member will have one vote except the Chairman who may have a casting vote if the two numbers of votes are equal.
A motion may be passed by a simple majority of members present.

6. OFFICE BEARERS AND COMMITTEE

6.1. The Association COMMITTEE shall consist of:

(i) A Chairman
(ii) A Secretary
(iii) A Treasurer (NO deputy treasurer)
(iv) A Vice-Chairman
(v) A Deputy Secretary
(vi) A Special Officer (e.g. for Maintenance)
(vii) The Induna
(viii) A Key Person (e.g. School Principal, Nurse, etc.)
(ix) Two other members with special duties, e.g. Publicity/Secretary

6.2 Members of the COMMITTEE shall be elected by the Association at its Annual General Meeting.

6.3 The term of office of the COMMITTEE shall be........................

7. MEETING OF THE COMMITTEE

7.1. The COMMITTEE shall meet at least every.................... months.

7.2. At least................ COMMITTEE members must be present for the meeting to be proper.

7.3. Each committee member will have one vote with the Chairman having a casting vote in the event of the voting being even.

7.4 The Chairman or his deputy must run the meeting.

7.5 Forfeiture of Membership: Membership of the Committee shall cease on the failure of any member to attend.................. (no.) consecutive meetings, without an excuse.

8. POWERS AND DUTIES OF THE COMMITTEE

8.1. The Association's Committee shall be responsible for carrying out the aims and objectives of the Association subject to the Authority of the Tribal Authorities.

8.2 The property and management of the affairs of the Association shall be vested in the Committee.

8.3. In the event of a dispute or disolution of the Association the Tribal Authority shall decide on a fair distribution of its assets unless such matters can be divided in a normal way at an Annual or Special General Meeting.

8.4. The Treasurer shall be required to keep an accurate record of all financial transactions which must be made available for inspection by any member at any time.

8.5. The Secretary must keep accurate records of every meeting in a MINUTE BOOK which must be signed as correct by the Chairman with the consent of the majority of members present at meetings.

8.6. The Chairman shall call all meetings, regulate the way meetings are run and ensure that all affairs of the committee and Association proceed smoothly.

8.7 Special Committee members shall be appointed to undertake special tasks, e.g. Publicity, Maintenance, etc.

8.8. It shall be the collective duty of all Committee members to ensure that an Annual General Meeting is held at which there should be a new election of members. The Chairman should co-ordinate the meeting.

9. FINANCES

   9.1. The treasurer will be responsible for the giving of receipts for all money received by the Association and account for all money paid out. He/she will act subject to the instructions of the COMMITTEE.

   9.2. An account will be opened in the name of the Association and all money received will be banked.

10. AMENDMENT OF THE CONSTITUTION

   10.1. Amendment of the Constitution shall only be made by a twothirds (2/3rds) majority of paid-up members of the Association at an Annual General Meeting or Special Meeting.

11. REGISTRATION

   11.1 Before the Committee is formally constituted it should have the consent of the Tribal Authority.

   11.2 The Department of Health and Welfare should be notified about the existence of the Committee.

12. ADDITIONAL RULES

Signatures of Founding Members: Date

....

....

....

....

....

....

....

....

....

....

....

....

Approval of Tribal Authority Date

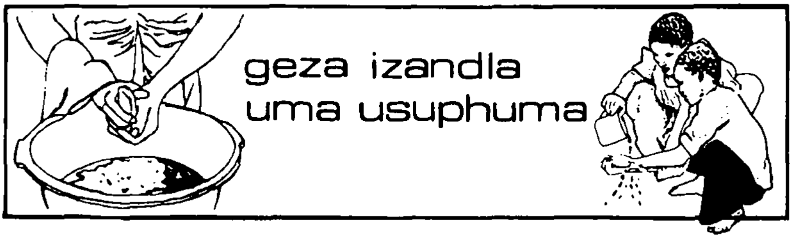
....

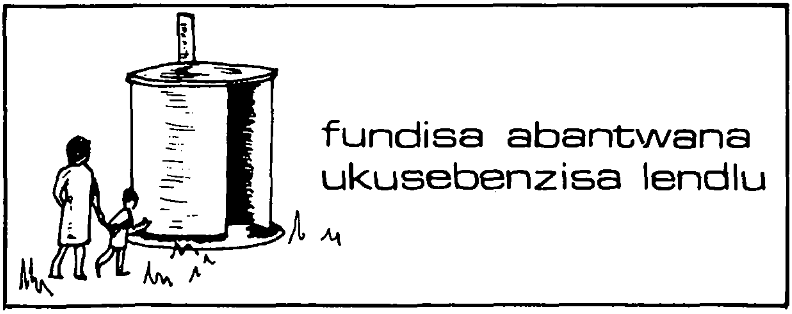
....

....

Appendix B

HEALTH EDUCATION SIGN FOR TOILET etc.





1985 marks the midpoint of the International Drinking Water Supply and Sanitation Decade whose goal set by the United Nations is "clean water and adequate sanitation for all people by the year 1990".

A pilot piped-water supply project, administered by the community

This booklet describes The Valley Trust's holistic response to this challenge. Starting with base-line data collected in 1980, it describes the spring protections, roof tanks, improved toilets and piped water supply project under way. As a small organisation operating in an area of 65 000 people, The Valley Trust has been concerned in the first half of the decade to establish techniques of conservation and methods of technology transfer. Some 30 spring protections, 40 tanks, 40 toilets and 1 piped water supply scheme later, The Valley Trust has experience to share with similar development agencies throughout Southern Africa, in both private and public sectors.