

Well Sinking

a step by step guide to the
construction of wells using
the blasting method



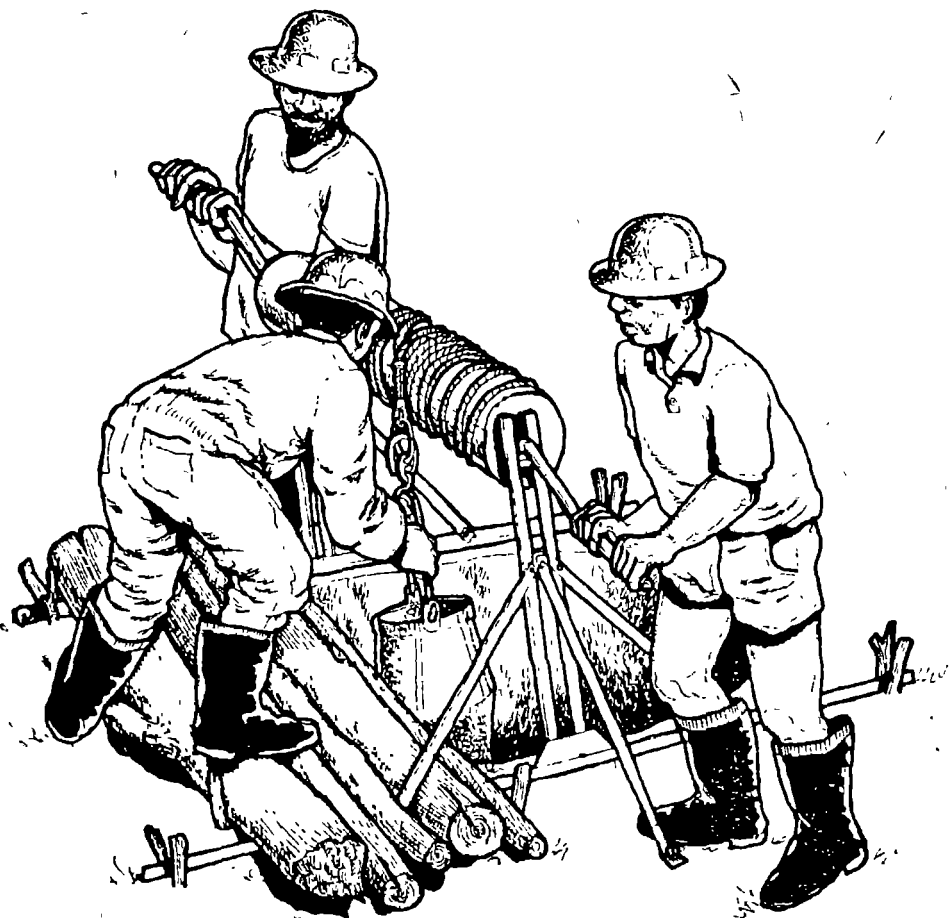
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What this book is about

This book describes in non-technical language the technique of hand-digging and blasting of wells. It is especially aimed at fieldworkers who are involved in projects where the cost is kept as low as possible and communities are encouraged to participate in the project.

The information is presented in four main parts, with the last part of the manual in the form of Appendices, contracts, record forms and other documents relevant to well sinking activities.

Acknowledgements

This manual was commissioned by the United Nations Children's Fund (UNICEF) in response to the call for community-based information about the technique of well sinking as used by governmental and non-governmental organisations in Zimbabwe. It is presented along with other media developed specifically for the International Drinking Water Supply and Sanitation Decade (IDWSSD).

It would not have been possible to complete this manual without the many fieldworkers who gave their time so willingly to explain techniques and pass on information to the author. Special mention must be made of those workers in Manicaland Province of Zimbabwe who happily joined us on field trips, answered endless questions and volunteered so many vital facts.

Finally, to UNICEF Project Staff and all those who participated in the evaluation of the Draft Manual, our thanks for their support at all times.

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May 1987

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By E S Ndoro Director, District Development Fund

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FOREWORD

Obtaining water from the ground for domestic purposes by the construction of deep dug wells originated thousands of years ago. Many of these ancient wells continue to provide their communities with reliable water supplies in different parts of the world.

Over most of Zimbabwe the water table is less than 20 metres from the surface and well digging is therefore possible in some areas of every district in the country. Such areas should be delineated during preparation of proper district water and sanitation plans.

Wells can be sunk even in rocky areas with the use of explosives. The well digging technique described in this book, which includes the use of explosives, has been developed to suit conditions found in Zimbabwe. DDF has been sinking wells on a small scale for many years but since Independence almost three thousand wells of this type have been completed mostly with the support of non-governmental organisations, principally the Lutheran World Federation. In addition, UNICEF has assisted DDF to introduce this technique in a number of districts.

This type of water development lends itself to district level management by DDF Water Division district staff because it does not rely on the use of expensive and sophisticated machinery. Dug wells have other advantages; they are usually considerably cheaper than mechanically drilled boreholes; they provide employment for rural people; they allow scope for community participation and can be deepened by the community if the water table falls. The technique has therefore an important role to play in the development of rural ground water supplies and takes its place beside shallow dug wells which can be managed entirely by voluntary community labour, hand augered boreholes and mechanically drilled boreholes. The most appropriate and cost effective technique should be used in each case. This information should form part of the district water and sanitation plan and it is expected that this publication will enhance the planning of water and sanitation schemes at district level.

I therefore commend this very useful book to all field workers especially DDF Field Officers and Supervisors involved in the provision of water to our rural communities.

E S Ndoro
Director
District Development Fund



INTRODUCTION

Water and Community Health

Most diseases in Zimbabwe are related to poor environment and a high proportion of our health problems are caused by a lack of water and sanitation. The provision of an adequate supply of clean water and safe excreta disposal is therefore of great importance in improving community health. However new water supplies and sanitation facilities alone will not have much effect on the health of a community unless the people learn why a new facility is necessary, in what way it can contribute to better health and also how to use and maintain it properly.

In starting a well sinking project it is therefore very important that project workers explain the benefits of the new supply and also promote health as an important advantage of water development.

This can be done by involving the community in explanations and discussions about the spread of diseases such as diarrhoea, sore eyes, bilharzia and other health problems which can occur through inadequate or poor water supplies and sanitation. It is also necessary to explain about the need for improved hygiene in the home, for example, the washing of hands, safe handling of food, using larger quantities of water for bathing, covering water containers when not in use and so on

On completion of the project, the community should be taught the importance of maintaining the pump which is installed for raising water from their well so that they can look forward to a steady supply at all times. It is also essential that the people learn the value of maintaining the area around their new supply so that it does not become contaminated and foul. These maintenance activities are often carried out through Water Committees who are elected by the people to supervise and share responsibilities.

To achieve these objectives we must try to:

- be sensitive to the needs of communities
- listen to the problems of each community
- help communities to determine their own needs
- guide communities towards identifying the need for water projects in their area
- explain the roles of different people in the project
- show the users of the supply how to maintain the project
- be available to assist when help is required
- hand the project over to the community on completion

**We should also show our commitment to progress
in the country and lead by good example.**

In order to assist Project Workers to communicate health information to the people, we list some examples of excreta and water related problems and what can be done to prevent them at community level.

CAUSE OF HEALTH PROBLEM	DISEASES WHICH MAY RESULT	WATER SUPPLIES WHICH MAY CAUSE THE DISEASE	POSSIBLE SOLUTIONS
<p>GROUP 1 PROBLEMS CAUSED BY DRINKING POLLUTED WATER</p>	<p>DIARRHOEA, TYPHOID, CHOLERA, DYSENTERY, INFECTIVE HEPATITIS (JAUNDICE), POLIOMYELITIS, AMOEBIASIS</p>	<ul style="list-style-type: none"> • SHALLOW UNPROTECTED WELLS • RIVERS • UNPROTECTED DAMS • SPRINGS 	<ol style="list-style-type: none"> 1. IMPROVE EXISTING SUPPLIES 2. BUILD, PROTECT AND MAINTAIN NEW SUPPLIES WHICH PROVIDE ENOUGH WATER FOR THE NEEDS OF THEIR OWNERS 3. ENCOURAGE SANITATION PROJECTS IN THE AREA. COMBINE SUCH PROJECTS WITH HYGIENE EDUCATION 4. ENCOURAGE HYGIENIC PRACTICES FOR WATER COLLECTION, STORAGE AND USE 5. ENCOURAGE FREQUENT HANDWASHING, PLENTIFUL USE OF CLEAN WATER FOR BODY AND HOME HYGIENE (SEE GROUP 2 ALSO)
<p>GROUP 2 PROBLEMS THAT OCCUR BECAUSE THERE IS NOT ENOUGH WATER</p>	<p>DIARRHOEA, TYPHOID, CHOLERA AND HEPATITIS SKIN INFECTIONS: SCABIES, SEPTIC SORES, RINGWORM AND COMPLICATIONS WHICH RESULT FROM THESE INFECTIONS. EYE INFECTIONS: CONJUNCTIVITIS, TRACHOMA</p>	<p>LIMITED SUPPLIES (EG SHALLOW WELLS, WATERHOLES) SUPPLIES WHICH</p> <ul style="list-style-type: none"> • ARE VERY DISTANT FROM THE HOME • HAVE VERY LITTLE WATER • SERVE MANY PEOPLE <p>THESE PROBLEMS LEAD TO A LACK OF AVAILABLE WATER FOR HYGIENE AND HOME USE, I.E.</p> <ul style="list-style-type: none"> • FREQUENT HANDWASHING • BODY WASHING, ESPECIALLY FACE AND EYES • WASHING OF COOKING UTENSILS • CLEANING THE HOME 	<ol style="list-style-type: none"> 1. SITE AND BUILD, PROTECT AND MAINTAIN SUPPLIES WHICH CAN PROVIDE ENOUGH WATER FOR THE DAILY NEEDS AND CLOSE TO THE HOMES OF EVERY FAMILY WHICH USES THEM 2. COMBINE HYGIENE EDUCATION WITH WATER PROJECTS AND ESPECIALLY ENCOURAGE: <ul style="list-style-type: none"> • USE OF MORE WATER FOR BODY HYGIENE AND OTHER HOME ACTIVITIES • FREQUENT HANDWASHING 3. ENCOURAGE SANITATION PROJECTS IN THE AREA 4. ENCOURAGE PEOPLE TO USE AND MAINTAIN THEIR FACILITIES

CAUSE OF HEALTH PROBLEM	DISEASES WHICH MAY RESULT	WATER SUPPLIES WHICH MAY CAUSE THE DISEASE	POSSIBLE SOLUTIONS
<p>GROUP 3 PROBLEMS CAUSED BY CONTACT WITH INFECTED WATER</p>	<p>BILHARZIA (THE INFECTIVE BILHARZIA GERMS GROW IN SNAILS WHICH LIVE IN WATER THAT HAS BEEN POLLUTED BY HUMAN EXCRETA)</p> <p>NB. BILHARZIA CAN BE CONTRACTED ONLY THROUGH WATER AND NOT FROM USING DIRTY LATRINES AS MANY STILL BELIEVE</p>	<p>UNPROTECTED SUPPLIES IN WHICH BILHARZIA SNAILS BREED, EG</p> <ul style="list-style-type: none"> • RIVERS • DAMS • STREAMS • PONDS, LAKES ETC • SHALLOW WATER WHERE VEGETATION GROWS EASILY 	<ol style="list-style-type: none"> 1. ENCOURAGE USE OF PROTECTED WATER SUPPLIES TO AVOID CONTACT WITH INFECTED WATER 2. DISCOURAGE USE OF UNPROTECTED WATER SUPPLIES FOR RECREATION 3. PROMOTE USE OF LATRINES TO PREVENT CONTAMINATION OF WATER 4. SPREAD AWARENESS ABOUT BILHARZIA 5. CLEAR VEGETATION NEAR WATER WHICH CAN HARBOUR BILHARZIA SNAILS
<p>GROUP 4 PROBLEMS CAUSED BY INSECTS WHICH BREED IN WATER</p>	<p>MALARIA, MOSQUITO BITES</p>	<p>OPEN WATER SUPPLIES SUCH AS SHALLOW POOLS, SWAMPY AREAS</p> <p>MOSQUITOES ALSO BREED IN WATER WHICH IS LYING IN OLD TINS, CAR TYRES AND IN LONG GRASS AROUND THE HOME</p>	<ol style="list-style-type: none"> 1. PROTECT WATER SUPPLIES CLOSE TO THE HOME 2. DRAIN SWAMPY AREAS AROUND WATER SUPPLIES 3. CLEAN AWAY PLACES IN AND AROUND THE HOME WHERE MOSQUITOES CAN BREED 4. ENCOURAGE LIMITED STORAGE OF WATER WHERE POSSIBLE, AND ALWAYS IN COVERED CONTAINERS 5. ENCOURAGE PEOPLE TO TAKE MALARIA TABLETS REQUIRED TO PREVENT THE DISEASE 6. USE MOSQUITO NETS IF POSSIBLE

PART ONE

Planning and organising a well sinking project

It will take a long time to achieve the goal of **Water for All** if individuals work alone on projects. It is better if families join groups to improve community water supplies. The Government of Zimbabwe recognises this need and encourages co-ordinated efforts towards water development. For example, the Ministry of Health assists the community with shallow well-digging projects. The Ministry of Energy, Water Resources and Development assists by organising borehole and deep well-sinking projects in the country. Non-governmental organisations also work closely with community groups.

The District Development Fund (DDF) plays an important role in water development at district level. It is through this arm of the Government that many well sinking projects are organised. DDF also employs and trains well sinkers to use the technique of blasting to deepen wells in areas where access to water is prevented by hard rock. The work of DDF is co-ordinated at district level by the District Administrator and District Council. DDF workers co-ordinate their efforts with staff from other ministries, political structures, other community based workers and, most important, the community. This is done through the District Development Committee. Each member of the DDF has an important role to play in development and in the next pages we describe the work of those specifically concerned with well sinking projects in the country.

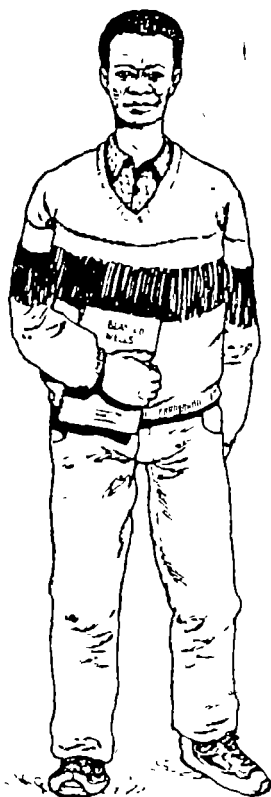


The role of the DDF team in well sinking projects

The **DDF Field Officer** (water) holds overall responsibility for the supervision of DDF staff in well sinking projects in his district. In larger districts or projects involving many wells, the Field Officer is assisted by a Well Sinking Supervisor and Water Supply Operatives, who will supervise a number of Well-Sinking Teams.

THE Well Sinking Supervisor

- * **consults** the Water Supply Operative about contracting a Well Sinker and his team for a project
- * **ensures** that sufficient equipment and supplies are available to the Water Supply Operative and Well Sinkers
- * **issues** and maintains accurate records of explosives used for DDF well blasting activities in the District
- * **visits** well sinking projects to observe practices and offer advice
- * **ensures** that safety regulations are clearly understood and followed by all project workers
- * **measures** the work done every month and calculates the amount of payment due to the Well Sinker
- * **arranges** payment for the Well Sinker through the District Administrator (according to the contract (see Appendix C)
- * **keeps** accurate records of all well sinking projects in the District.



- * **checks** that all equipment belonging to DDF is returned, well cared for and safely stored when not in use

- * **arranges** with the Mining Inspector for trainee Well Sinkers to take a test to obtain a blasting licence.

The Field Officer is also responsible for co-ordinating well-sinking plans with other organisations working at District level.

The **Water Supply Operative** is responsible either directly to the Field Officer or through a Supervisor for well sinking projects in his District. He should be a trained blaster and usually has some experience in locating ground water. He therefore assists the community to find good well sites.

He supervises the Well Sinking Team ensuring that: .

- * **work** is carried out according to the contract (Appendix C and D)
- * **completed** work is measured and recorded accurately for purposes of payment
- * **delivery** of equipment and materials is co-ordinated so that the well sinkers do not waste time waiting, and so lose money and interest
- * **safety** regulations are followed exactly
- * **the Well Sinker** teaches correct blasting procedures to his team
- * **the Supervisor** is informed so arrangements can be made with the Mining Inspector for well sinkers to take their blasting licences
- * **equipment** is checked regularly, maintained and serviced whenever this is necessary
- * **the well sinking team** is properly accommodated and that arrangements for food are satisfactory.

The Water Supply Operative will carry out the blasting if the Well Sinker does not yet have a licence.



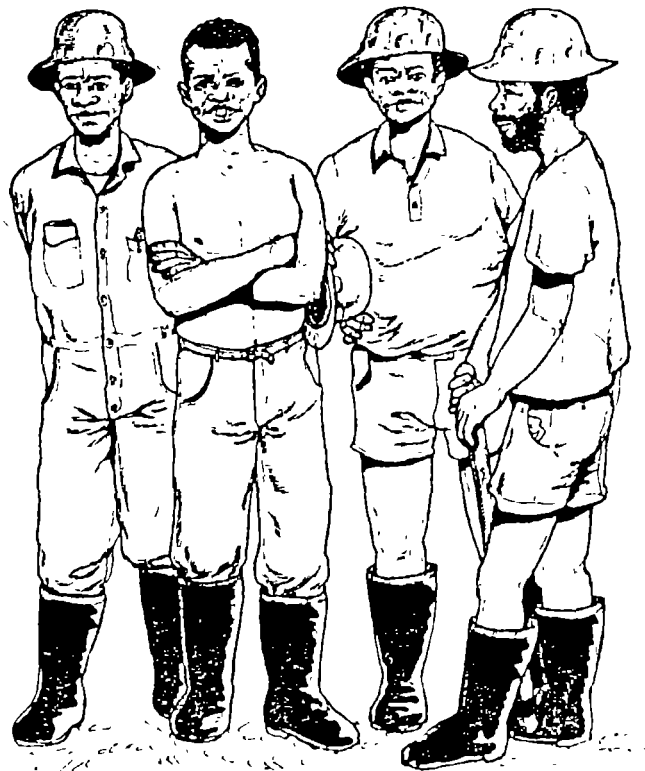
The **Well Sinker** should be a licensed blaster. He and his Team of three helpers are contracted through the Village Water Sub-Committee by the Village Development Committee (the VIDCO) to construct wells at sites.

These are selected by the Community with the assistance of the Water Supply Operative and others.

The Well Sinker is responsible to the Village Water Sub-Committee and the VIDCO for his activities. He is supervised by the Water Supply Operative.

According to formal contract (Appendix B) the **Well Sinker** agrees to

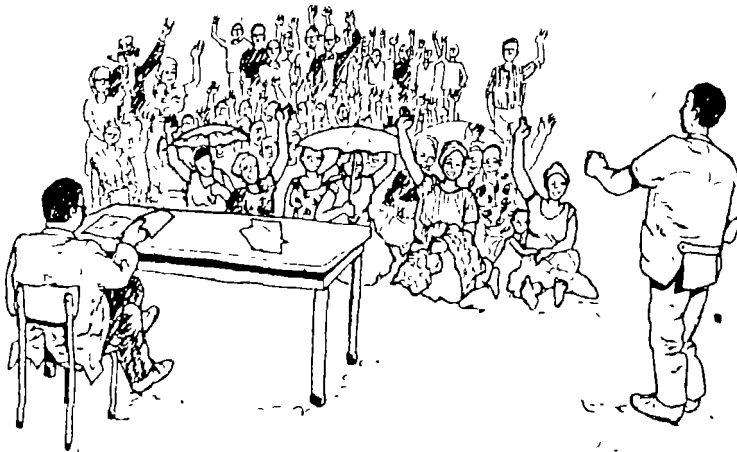
- * **complete** the well by digging or blasting after community efforts are finished (i.e. the well has been dug to a depth of at least 3 metres or to solid rock whichever is first reached),
- * **maintain** equipment supplied by DDF for the project
- * **use** supplies issued by DDF only for the project
- * **ensure** that the well is properly protected from children and animals during construction to prevent accidents
- * **abide** by safety regulations at all times
- * **train** his helpers in blasting techniques.



The Well Sinker and his team can be considered as Casual Employees of DDF They are entitled to Workmens' Compensation in case of accident

The role of the Community in well sinking projects

As the role of the Community in well sinking projects is very important, it is essential that the people are properly informed about project plans. It is also important that the people are given every opportunity to discuss their needs with the project team. Information can be shared at meetings and discussions which are attended by District Councillors, the VIDCO, representatives from DDF and different ministries involved in water development, community-based workers (e.g. Health Assistants, Health Inspectors, Local Government Promotion officers, Community Development Workers etc.), political leaders and others working in the area.



A vote is taken to see if the people want to participate in the project

It is at these meetings that the community can express their problems and needs and find out more about

- * **how** the well sinking project will operate
- * **who** will be involved in the project
- * **who** will be involved in choosing the site for the well
- * **what** contributions and assistance are expected from the community
- * **how** labour and contributions to the project are shared by the people
- * **what** the benefits of the project will be to the community
- * **how** to form a Village Water Sub-Committee
- * **who** will maintain the handpump and well surrounds
- * **who** to approach should any problems arise
- * **how** to calculate the work completed by the Well Sinker

At these meetings a **vote** is taken to see whether the people wish to participate in the project. A Village Water Sub-Committee of the VIDCO is then elected for each proposed well site.

The role of the Village Water Sub-Committee in well sinking projects

A Village Water Sub-Committee is elected to represent the people in every well sinking project. The Sub-Committee consists of three to four members from different families who will use water from the well. At least two members of the Sub-Committee are women. The Sub-Committee liaises between the people and the VIDCO. It is important that members of the Sub-Committee live in the village where the water supply is to be made.



A village Water Sub-Committee is formed to represent the people in every well sinking project.

Special responsibilities of the Sub-Committee include organising and motivating the people to

- * **participate** fully in each phase of the project
- * **dig** the first 3 metres of the well before the team takes over
- * **provide** broken stone, sand and transport to the project site
- * **prepare** food and provide accommodation for the team during the construction period
- * **co-ordinate** with the Water Supply Operative, VIDCO and the people
- * **measure** and record the amount of water removed from the well during construction and submit these records to the Supervisor or to the Water Supply Operative
- * **ensure** that the Well Sinkers complete their tasks according to the contract (Appendix C) before moving on to another project
- * **motivate** the community to assist with the completion and maintenance of the project.

(A typical Village Water Sub-Committee constitution is shown in Appendix A.)

PART TWO

Siting the village water supply

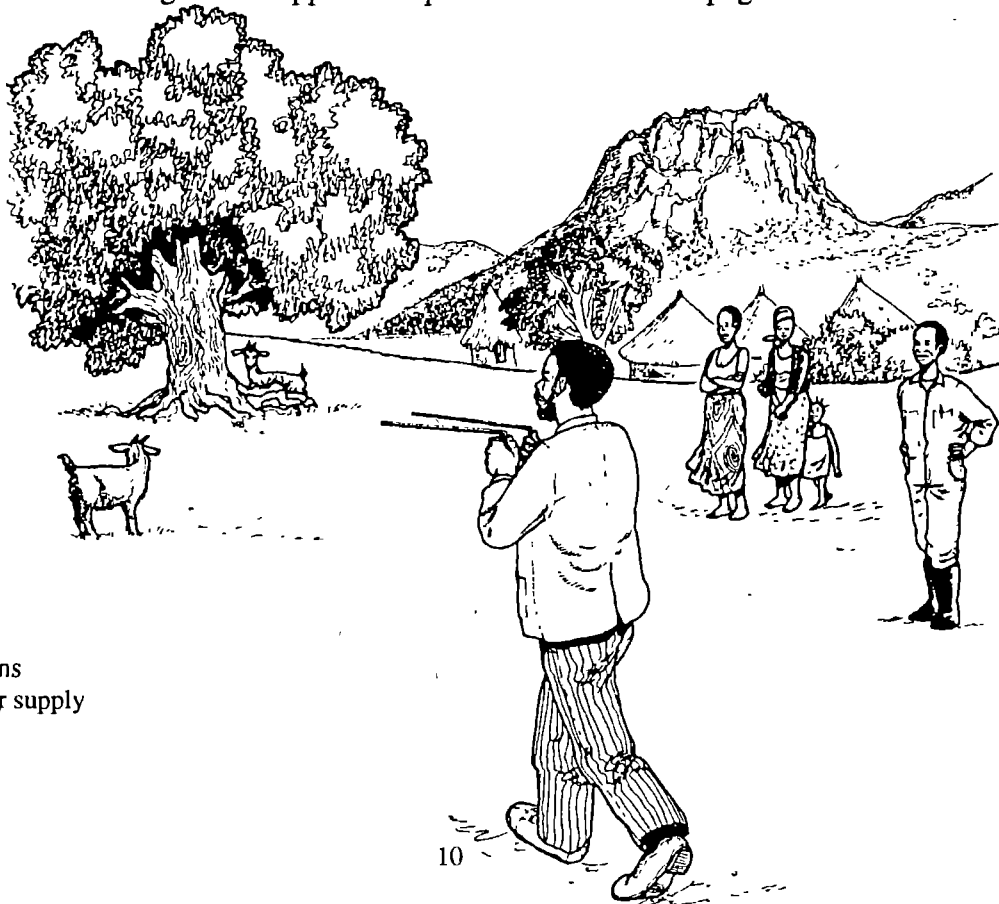
All our water comes from rain. Rainwater either collects above the ground in sources such as rivers or lakes, or it soaks through the ground. We therefore generally speak of **surface water supplies** (i.e. water above the ground) or **ground water supplies** (i.e. water under the ground).

Different methods can be used to reach ground water supplies. If the ground water is close to the surface then a shallow well can be constructed. If the water is deep below the surface and there is a lot of rock preventing access to a good underground supply, then it is usually necessary to blast a deep well or drill a borehole.

It is natural for Project Workers to hope that they will strike a good supply of water when they are constructing a new well. Although it is difficult to predict that the new supply will be good, there are many natural signs that well sinkers can use in looking for a suitable site. This would include, for example, looking at the vegetation in the area, finding out about the rainfall, studying the catchment area and listening to those who have some experience about siting water supplies. There are also traditional water diviners in many parts who often use a 'Y' shaped stick or thin copper divining rods for this task. Trained workers from Government Ministries and Non-Governmental Organisations will also assist the people to site their water supplies.

In selecting the site for a new well, it is very important that the future users of the water supply also participate in decision-making. In particular women must be consulted so that the well site is conveniently situated near to all the households.

Some guidelines for siting water supplies are presented on the next page.



Use natural signs
to site the water supply

Some other guidelines for siting water supplies

CHARACTERISTICS OF THE AREA	WHAT TO LOOK FOR
1 Relief	<p>SURFACE water (in river streams, etc) flows downhill. UNDERGROUND water usually follows the slope of the ground. Try to site supplies in:</p> <ul style="list-style-type: none"> * low places (but not in swamps or river beds) * sites which have a good catchment area (i.e. sites which are easily re-supplied with water because it flows from higher ground. <p>This is important because wells sited too high on a slope may dry up in the dry season.</p>
2 Soils and rock	<p>The presence of certain kinds of rock and soil can help to detect underground water supplies. Experience in identifying rock formations can be gained through OBSERVATION and working with knowledgeable people who have dug wells in the area. Look for:</p> <ul style="list-style-type: none"> * weathered rock; * huge anthills which possibly indicate deep, well drained soils; * granite rock with 'iron' staining in the fracture lines; * fine black soils. <p>AVOID rock outcrops which are not weathered.</p>
3. Vegetation	<p>Vegetation is useful in guiding the surveyor to choose sites for water. Look for:</p> <ul style="list-style-type: none"> * lines of vegetation indicating water * certain trees like the muchakata or muonde which usually indicate good water supplies; * certain grasses which remain green all year and grow well near water
Choose sites which	<ul style="list-style-type: none"> * are at least 30m from latrines, diptanks and cattle kraals * are convenient for all the users, i.e. within 1km of their homes * will provide sufficient water for users throughout the year * are approved by the people * are near rivers and streams so their catchments can be used.
Avoid sites where	<ul style="list-style-type: none"> * the water is salty * flooding and waterlogging can easily occur * the area is shunned by the people for religious or cultural reasons.

Materials and equipment needed for well sinking

The equipment necessary for the task of well sinking, blasting, lining the well and other activities is listed at the back of this book in Appendix B.

Responsibilities for ordering, issuing, storing and maintaining the equipment are as follows:

The Well-Sinking Supervisor

(under the direction of the Field Officer)

- * **estimates** equipment and materials needed for the project, makes issues and accounts for its distribution.
- * **issues** materials and equipment to reach the well sinking team in good time to commence the job.

The Water Supply Operative

- * **passes** requests for materials and equipment from the well sinking team to the Well-Sinking Supervisor.
- * **regularly** checks equipment and materials used by the team at project level.

The Well Sinking Team

- * **receives** materials and equipment for project use from the Water Supply Operative.
- * **checks** materials and equipment regularly.
- * **stores** materials and equipment correctly.
- * **maintains** equipment regularly.

Community participation in digging the first three metres of the well

After it has been decided to have a well-sinking project, a contract between the VIDCO and the Well Sinker is signed. (see Appendix C). According to this agreement the community will

- * **start** digging the well after the site has been approved by DDF, with a diameter of 1,5 metres down to rock or depth of 3 metres whichever is reached first
- * **provide** necessary accommodation and assistance with food for the well sinker and for his labourers for the period of construction after the community digging is completed
- * **provide** clean broken stone and sand for concreting the well lining, cover slab and cattle trough
- * **witness** the removal of water from the well to check that work is not stopped before 100 mining buckets are obtained on two consecutive days (i.e. 100 buckets a day)
- * **provide** a layer of stones around the well to protect against erosion
- * **construct** a fence around the well
- * **look after** the well and handpump and ensure that they are properly used and maintained
- * **transport** the well sinking equipment from site to site.

For the community to successfully complete this stage of the project, they should follow these steps:

- * **clear** and level a suitable working place around the well site
- * **mark** out places where sand, stone, cement, water and equipment can be stored for use during later stages of the project
- * **mark** out the well on the ground, (diameter 1,5 metres)
- * **commence** digging; remove soil as the hole deepens
- * **dig** to a depth of at least 3 metres
- * **check** that the sides are straight and that the diameter remains 1,5 metres as the hole is deepened.



Community participation in Well Digging

If hard rock is reached, and further digging becomes impossible, the Village Water Sub-Committee should consult with the DDF Water Supply Operative.

The arrival of the well sinking team

After the community have finished digging, the Well Sinking Team will be brought to the site to take over and complete the project. At the project site the Well Sinker and his Team are introduced to the Village Water Sub-Committee and the people. Arrangements for food and accommodation are then explained to the team.

The materials and equipment necessary for the project will also be transported to the site by DDF. If the site is very difficult to reach, the community may be asked to assist by clearing a road, or providing local transport, eg ox cart, for the equipment and other materials.

NOTE Explosive materials for blasting are transported in dry, clean, sealed containers, i e. cardboard boxes or rubber containers. Only authorised persons may convey explosives and a licence to do this must first be obtained from the Mining Inspector who is the Inspector of Explosives (See Appendices E, F, G and H).



Safety for the well sinker and his team

Well sinking is dangerous work! Great care is needed to avoid accidents which can result in serious injury or death. Certain regulations are required by law. These refer to:



1 Protective clothing

The Well Sinker must ensure that each member of his team uses these items of protective clothing:

- * **an overall**
- * **Miner's helmet** when working down the well
- * **a pair of gum boots** when working down the well
- * **rope handling gloves** when handling the wire rope.

2 Conduct on the job

The Well Sinker will ensure that each member of the team

- * **is sober on duty**
- * **carries out his duty according to instructions**
- * **abides by all the safety regulations**
- * **is on site and on time as requested.**

3 Safety at the site

The Well Sinker must ensure that

- * **the well** is adequately covered with thorn branches or poles when digging is not in progress so animals and children do not fall inside
- * **the well** is not covered at any time with steel or tin because this will prevent dangerous gases from escaping
- * **the windlass handle** is secured by wire when not in use
- * **the people** in the community are warned when blasting will take place
- * **a red flag** for danger is flown at all times near the well site
- * **well sinkers** do not enter the well until 12 hours after blasting.

The well sinking team at work

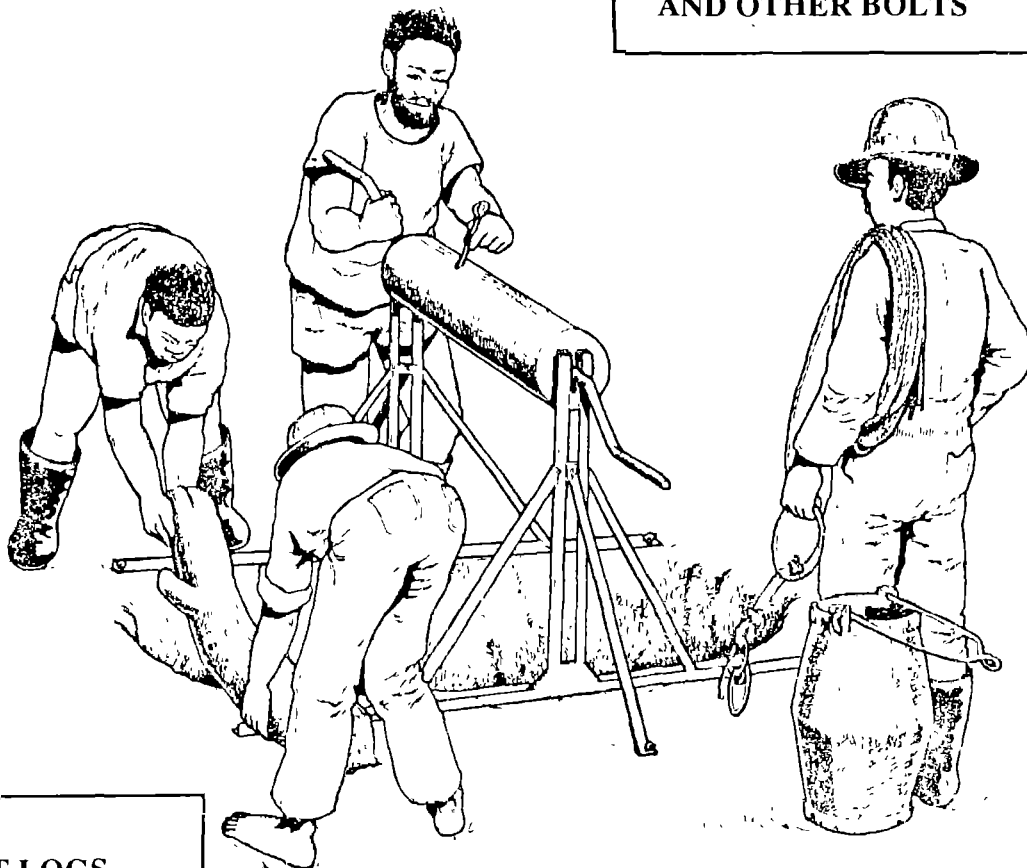
DEEPENING

STEP 1 Setting up the windlass

A windlass is assembled above the well. It is used to lower the well sinkers into and raise them out of the well. It is also used to raise soil, rock and water to ground level.

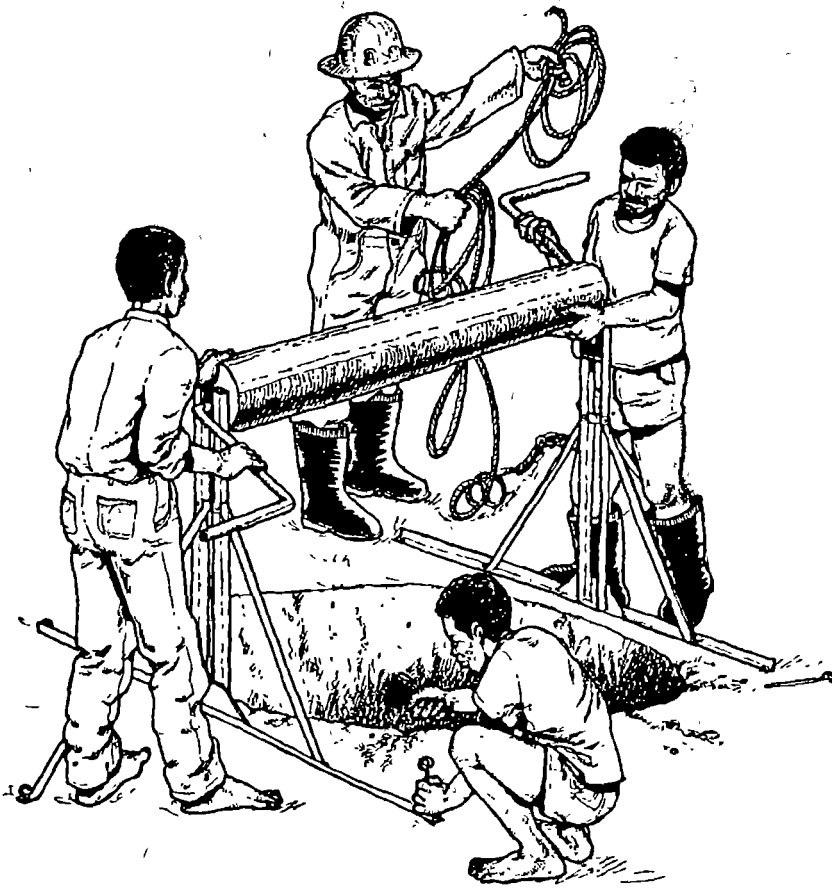
Before the Well Sinking Team starts work, these daily windlass checks must be made.

**Check 1
TIGHTEN EYE BOLTS
AND OTHER BOLTS**



**Check 2
SUPPORT LOGS**
Remove stones from
under support logs
Ensure logs are stable
and not rotten

Daily windlass checks for safety

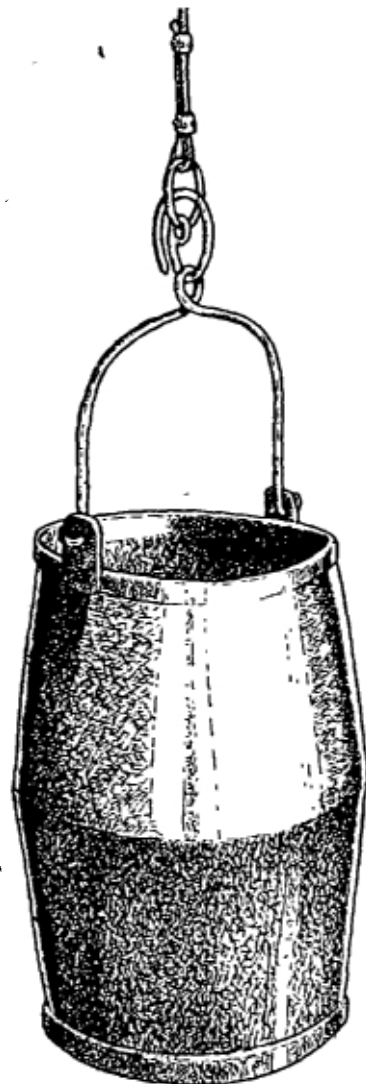


**Check 3
WIRE ROPE**

*** Inspect wire rope
for broken strands.
Do not leave old rags
tied around the wire
as this can hide any
damage**

**Check 4
CROSBY CLAMPS**

*** Inspect
* Tighten**



**SAFETY BELTS AND SAFETY ROPES SHOULD ALWAYS BE
AVAILABLE AND IN GOOD CONDITION**

STEP 2

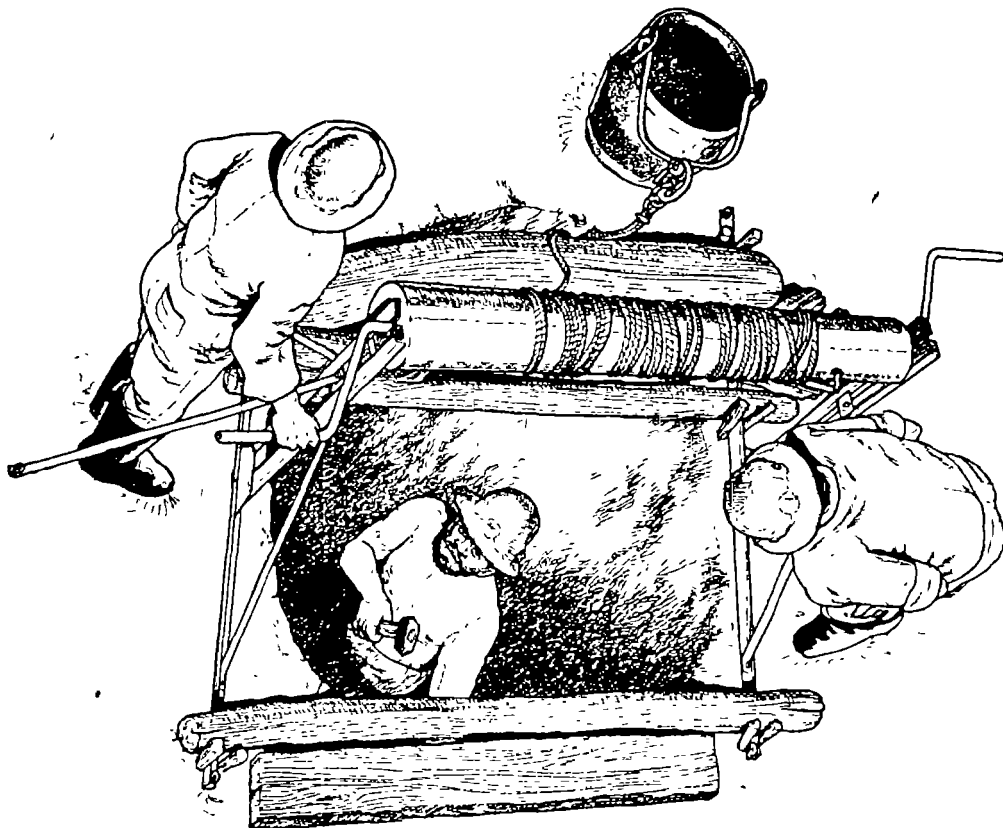
Deepen the well by digging

After the community has dug the first 3 metres, the Well Sinking Team takes over, and continues to deepen the well using picks, shovels and the miner's bar. As the ground becomes more rocky, and progress becomes slower, the decision to use blasting may then be taken.

In stable soil which does not collapse easily the Well Sinking Team must **reduce** the diameter of the well from 1,5m to 1,2m when hard rock is reached (i.e. usually around 5-6m deep). This reduction in the diameter produces a natural **foundation** for the concrete lining.

Unstable soils may collapse easily as the well is deepened. Beware of reducing the diameter of the well too soon! This is to prevent the erosion of the foundation which may cause the lining to collapse into the well. It may be necessary to line the well almost from bottom to top in unstable soils.

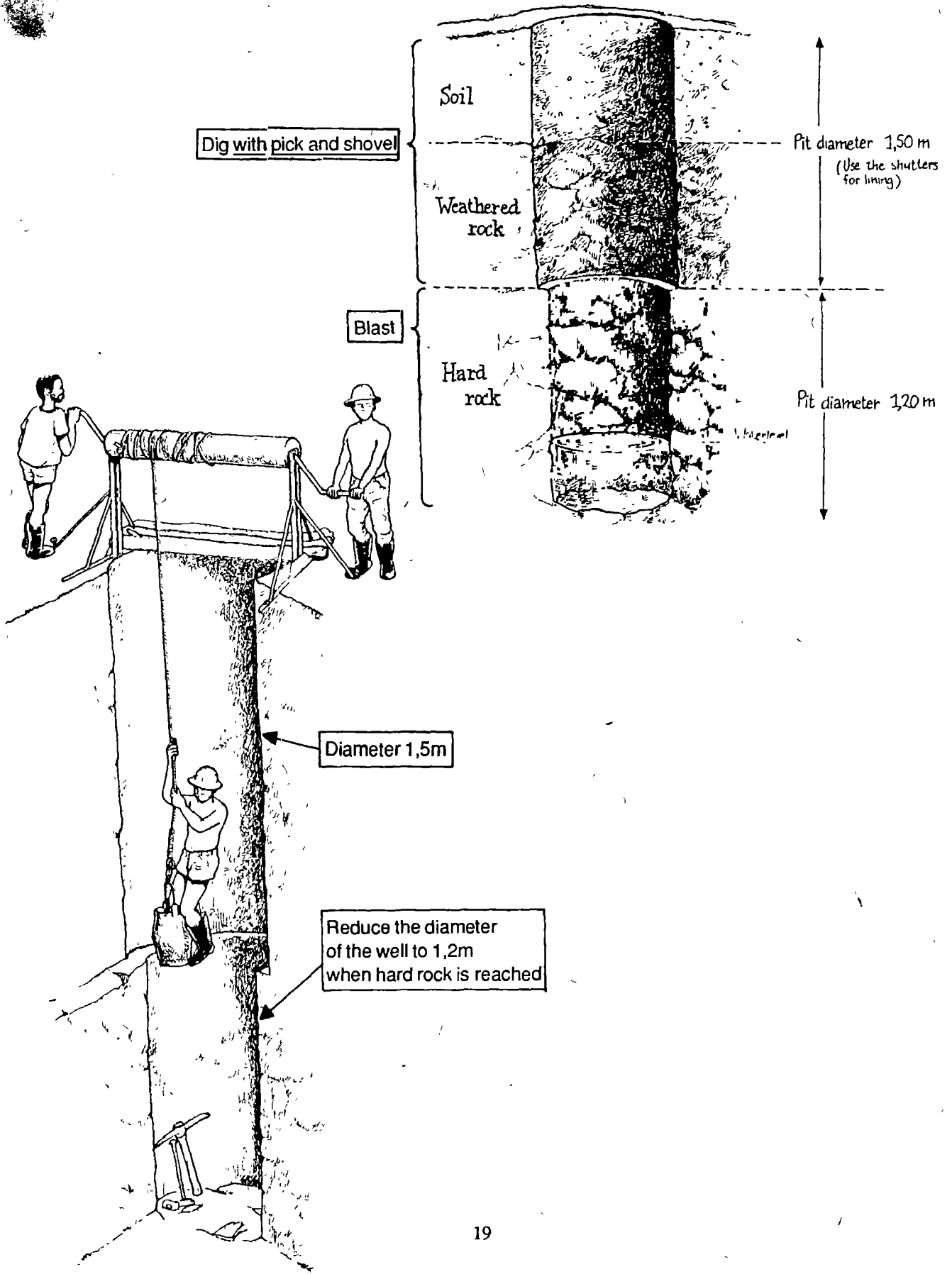
Deepening the well
by digging



SAFETY Note!

Well Sinkers are lowered and raised from the well in the mining bucket. This is attached by steel cable to the windlass. Mining helmets are worn at all times during the well sinking operations.

Reducing the diameter to 1,2m as hard rock is reached



STEP 3

Deepen by blasting the hard rock

In most well digging projects, a stage is reached where it becomes impossible for the Well Sinking Team to dig any further. This is because rock is obstructing progress and it therefore becomes necessary to use the **blasting method** to break up the hard rock.

Blasting can only be carried out by a qualified and licensed blaster. A blasting licence is granted to those persons who have satisfied the Mining Inspector in a test which covers all aspects of blasting and the use of explosives. (See Appendix F). It is usual for the Well Sinker to hold a Blaster's licence. The Water Supply Operative should also be qualified to blast the well. Unqualified people are not allowed to blast the well.

There are Government Regulations controlling the purchase, transport, storage, possession and use of explosives. These can be obtained from the Mining Inspector (Inspector of Explosives). The regulations must be carefully followed at all times.

The work of the licensed blaster

The Blaster will inspect the well to decide:

- * the kind of rock which is obstructing the well
- * the pattern and depth of the holes in preparation for blasting
- * the kind of explosives to be used
(ie Ammon gelignite 60% or Sinex slurry)
- * the amount of explosive charge necessary to blast the holes.

* The licensed blaster must also ensure that safety regulations as required by the law are carried out before and after the blasting operation.



Remember!

By law only authorised persons may obtain, transport, store and use explosives.

(See Appendices E, F, G and H)

The blasting procedure

The blasting operation is carried out by the licensed blaster. This task is co-ordinated with the Well Sinking Team, who:

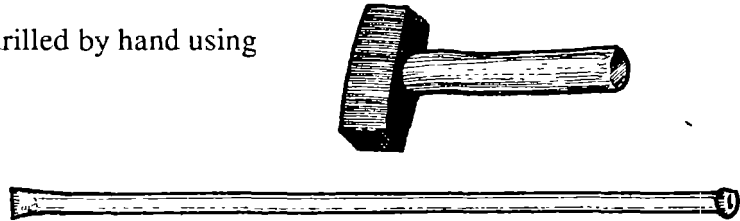
- * **must obey every safety rule for blasting**
- * **must obey each instruction issued by the blaster.**



Making the blasting holes

The well sinkers drill the charge holes at the base of the well. Explosive is packed into each hole. (See diagrams A and B.)

These holes can be successfully drilled by hand using
a 4lb hammer
a 0,6m and a 1,0m drill steel



Two types of drill steel are available:

- 1 In softer rock formations:** a solid hexagonal steel rod 22mm diameter with a sharpened point; this can be sharpened by a village 'blacksmith'.
- 2 In hard rock:** a solid hexagonal steel rod 22 mm diameter fitted with a 27mm tungsten carbide bit is recommended. This can only be sharpened in a workshop where a special grinding stone called a 'greenstone' is available.

Two kinds of holes are drilled at the base of the well.

1 Cutter holes are drilled in the centre of the blasting pattern. Cutter holes are 65cm deep and 40cm apart at the top. (see diagram). Cutter holes slant inwards. In decomposed rock 2 cutter holes are recommended.

In hard rock 3 cutter holes are recommended.

2 Trimmer holes are drilled around the edge of the blasting pattern (see diagram B). Trimmer holes are usually 8cm from the side, 50-55cm deep and slant outward.

With these patterns the well can be deepened from 45-55cm per blast.

Diagrams A and B show the position and depth of the cutter and trimmer holes inside the well.

Diagram A

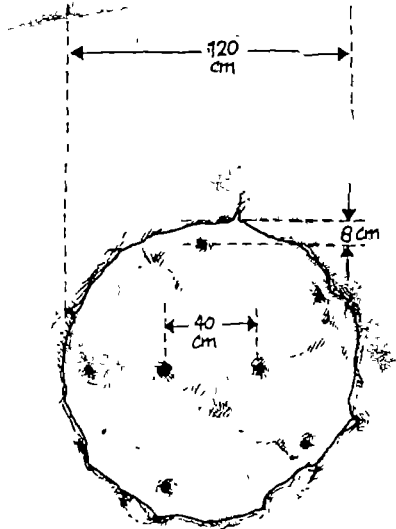
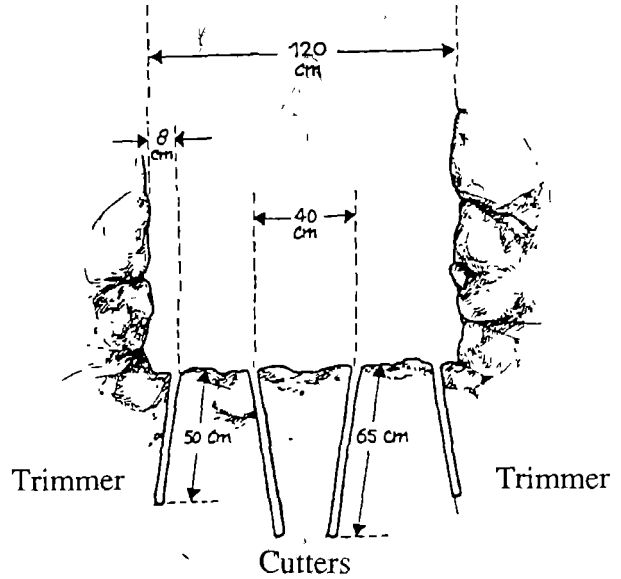


Diagram B



Water may seep from the well into the cutter or trimmer holes before drilling is completed. This water is easily removed by the well sinker, who uses a blow pipe (a short piece of hose) to suck out the water. Also water may need to be removed from the well using the mining bucket.



Drilling the cutter holes



Removing water from the cutter holes

Blasting: Step by step

To ensure that blasting is safe and successful the licensed blaster must follow these steps

1 Check the blasting pattern, the depth of the holes and remove excess water.

2 Assemble blasting materials needed for immediate, definite use.

There are **two** types of explosive:

a. Ammon gelignite 60% 25 x 200mm sticks

b. Sinex slurry 25 x 200mm cartridges. Sinex is preferable as it is locally made and safer.

In **addition** to explosives we need:

* detonator No. 6D

* fuse (Factory made connector capped fuse is better as fewer misfires occur)

* slow burning igniter cord.

3 Make up the primers

Pierce a hole with a wooden spike in the cartridge end and push in a detonator with fuse attached for about 8cm. Tie fuse and cartridge ends together with a piece of string.

4 Charging the primer

When using a Sinex slurry cut the primer's tube carefully in the length (lengthwise) with a knife. Lower the primer in the hole slowly with the fuse/cartridge connection facing upwards. Press down (do not ram) the cartridge in the hole with a stick.

5 Charging other cartridges

Cut the tubes of the cartridges if using Sinex as done for the primer, lower them down and press carefully.

6 Stemming

After priming and charging, each hole should be filled with dry river sand up to the top.

7 Igniter cord

The fuses must be connected using igniter cord so that the cutters ignite before the trimmers. Also the igniter cord should be connected so that each fuse has the possibility of being ignited from two sides to help minimize the risk of misfires. **A safe method of lighting the igniter cord is as follows:** Cover the bottom of the well and the igniter cord which links the fuses with damp green leaves. The end of the igniter cord is brought through the leaves and laid in a zig zag on top of them. This cord is ignited by dropping a 400mm length of igniter cord, lit at both ends, down the well. The leaves prevent the fuses igniting in the wrong order.

8. Getting ready for the blast

A signal is given that blasting is about to take place. The windlass barrel with the wire rope is removed and laid on the ground. The igniter cord is lit as described above. The well sinking team stand about 150 metres from the well.

9 The blast

After 3 minutes or so the detonators will initiate the blasts. The different explosions should be counted by at least three people to ascertain that all charges have been fired.

10 After blasting

Remember! Most fatalities in well sinking are due to gassing from nitrous fumes and carbon monoxide on re-entry to the well. It is very important that the well sinker waits for 12 hours after the charges have gone off, so that all the fumes can escape from the well.

Before re-entering the well, the well sinker should:

- * raise and lower the mining bucket into the well at least 20 times.
- * reduce the blast dust by spraying water (at least 1/2 drum) into the well

On re-entry for the first time, the well sinker should take a lighted candle into the well. If the flame does not burn properly, dangerous fumes are still present and he should leave immediately. He should also leave at once if he feels dizzy or faint.

If none of the charges explodes, the well sinker should wait about half an hour more before entering the well. If some, but not all the charges have gone off, the well sinker should wait 12 hours before attempting to deal with the misfires. The misfires can only be removed by scraping them out with a copper or wooden rod. Misfire holes should be washed out thoroughly using a water hose. Another solution is to remove the stemming and permit an immediate refiring by repriming the charge with a new primer.

No further drilling can be permitted until the misfired charge is taken out or blasted off. When the old explosives are removed from the misfire, they should be kept in a secure and closed box and destroyed at the time of the next blast. If refiring the charge is to be undertaken, it is essential to use a new primer cartridge every time.

How misfires can be prevented

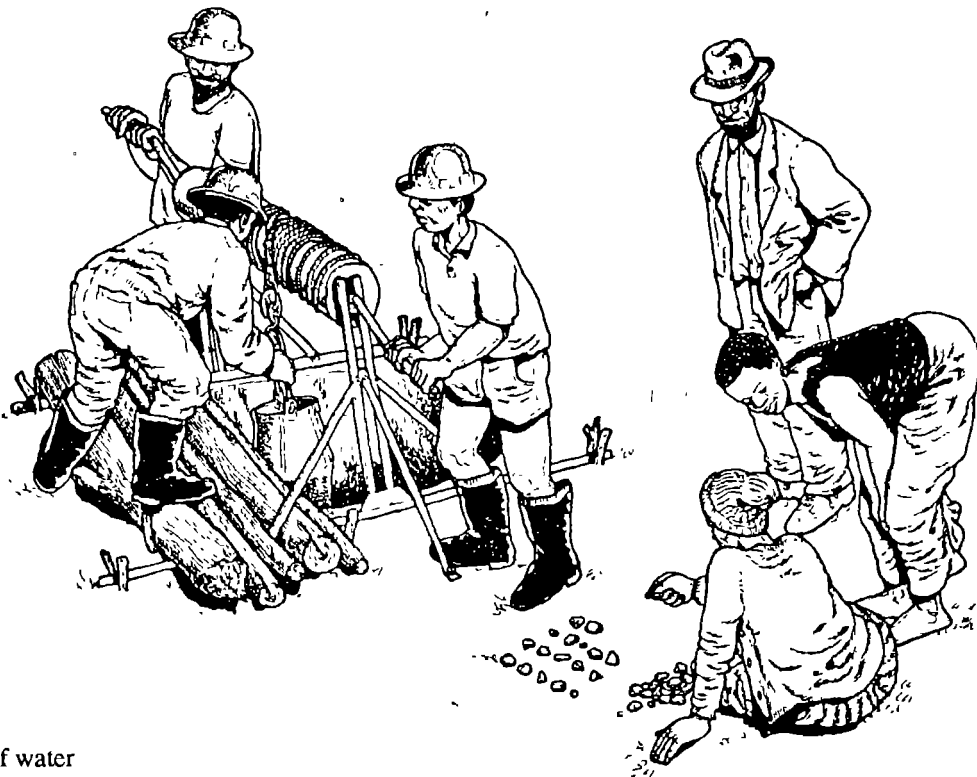
- 1 When lowering the primer into the hole, be certain that the fuse-detonator cartridge connection is facing *upwards*.
- 2 When stemming the cartridges into the hole, *do not* use a stick which is too thick. If the stick tightens slightly in the hole, there is a good chance the fuse will be damaged or be pulled out of the cartridges.
- 3 Press the stick down firmly (do not ram it) to avoid fuse damage.
- 4 Make the fuse/detonator connection waterproof.
- 5 Use factory made connector capped fuses especially when blasting in a well with water.
6. If detonators are purchased separately and need to be attached to the fuse, use the correct type of pliers for the job. **NEVER USE YOUR TEETH.**

Estimating the yield of the water supply before lining

It is very important to estimate the yield of the water supply before the task of lining is started. However, if the upper wall of the well is unstable it must be lined to allow digging to proceed safely. In DDF Well Sinking Projects this calculation is made by the Water Supply Operative or Supervisor, together with at least one member of the Village Water Sub-Committee. (See Appendix C and D). The yield is calculated by counting the number of mining buckets of water removed over two consecutive days (i.e. 2 days running).

For a community of 150-200 people, no less than 100 full mining buckets of fifty litres each should be removed each day. This will make a total of 5000 litres per day. If the amount is less, the Water Supply Operative will decide to either continue deepening the well or start lining.

In areas where the water table is completely unknown, the rock does not show signs of fractures, and there is no water after digging at least 15 to 20 metres, the project site may be abandoned. This decision is always reached in consultation with the Village Water Sub-Committee.



The amount of water taken from the well is recorded with the help of stones.

NOTE: The rates paid to the Well Sinker increase as the well produces more water. He will therefore wish to continue deepening as far as possible!

Lining a well

Introduction

After blasting is completed and the yield of the well has been measured and found to be satisfactory for the needs of the community, then the task of lining can be started.

This can be done in different ways. The method of lining where steel lining shutters are used and concrete is packed into the 10cm space between the shutters and the side of the well is described below.

In stable soils line the well from the 1,2m rock foundation upwards.

Where there is no rock, it is necessary to line the well from bottom to top to prevent collapse. Stones or bricks can be used below the water level. Spaces should be left between the stones/bricks to allow the inflow of water.

In wells where the soil collapses as the hole is deepened lining is difficult and expert advice is needed. It is possible, however, to line the well with concrete or pre-cast concrete rings as the well is deepened by the well sinkers. This technique is not described in this manual.

Extra materials and equipment for lining

In addition to those materials and tools used for deepening the well, additional materials and equipment are needed for the task of lining.

Materials and approximate quantities

Cement	2,5 bags per 1 metre lining
Clean river sand	4 wheelbarrow loads per 1 metre lining
Clean stone aggregate	8 wheelbarrow loads per 1 metre lining
Water	for mixing concrete
Old engine oil	for oiling shutter to prevent concrete sticking

Equipment

Steel lining	1 set of 1,3m x 1m internal shutters for lining inside the well
Shutters	1 set of 1,5m x 50cm external shutters for moulding the collar (NOTE Clean shutters with a wire brush, and oil before assembly.)

Working platform and chains

Tools

(See Appendix B)	Spirit level, Fencing pliers, Wooden float, Cold chisel, Builders bucket, Oil can, Trowel, Hacksaw, Wire Brush
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Involve the community in collecting materials for lining

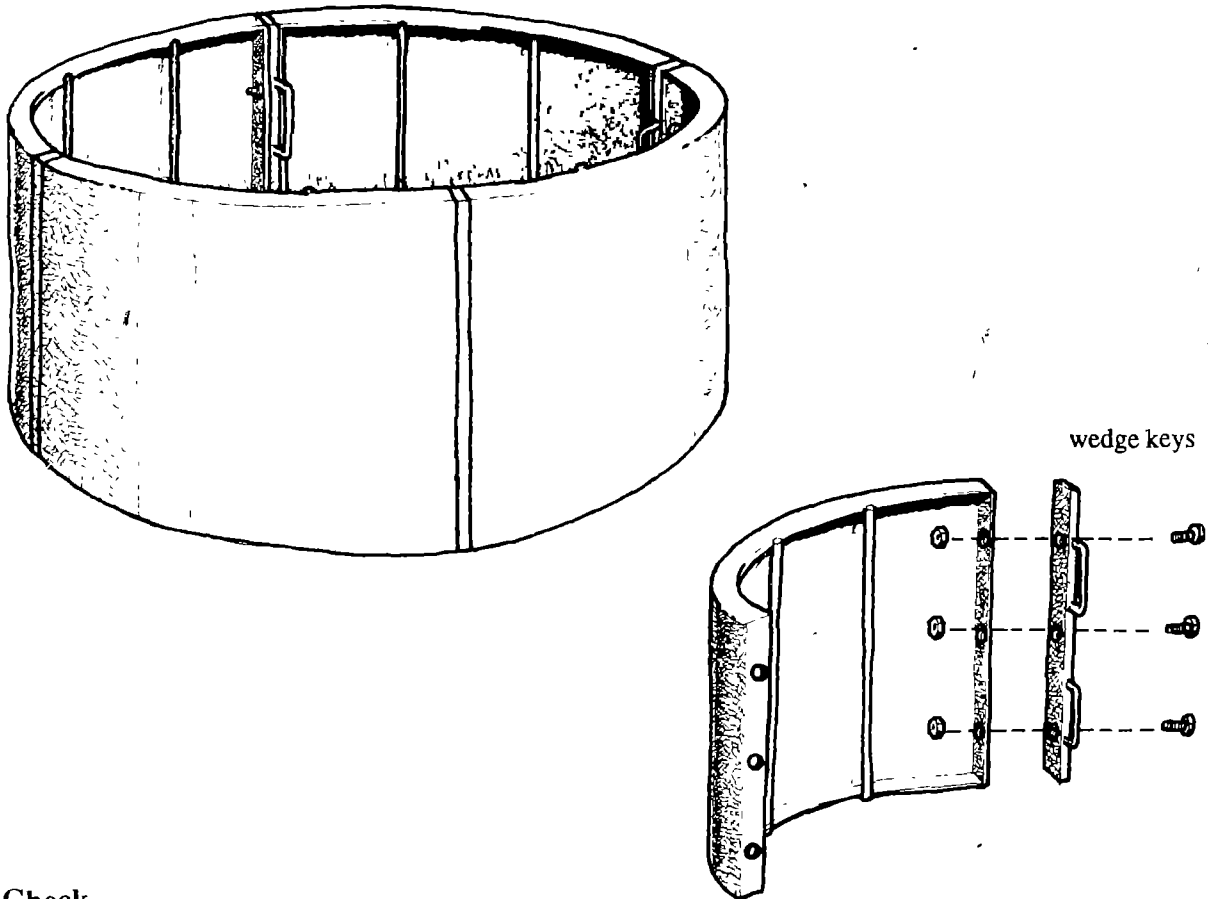
Concrete the well lining

To make a concrete well-lining using steel lining shutters, follow these instructions, step-by-step.

Step 1 Assemble the lining shutters

The steel lining shutter is made up of four pieces. Each piece is held together by bolts and wedge keys (see diagram). When fully assembled the lining shutter measures 1,3 metres in diameter and one metre in height. The lining shutter is lowered into the well with strong chains until it rests on the lining foundation inside the well. Concrete is poured into the 10cm space between the lining shutter and the side of the well to make a strong lining.

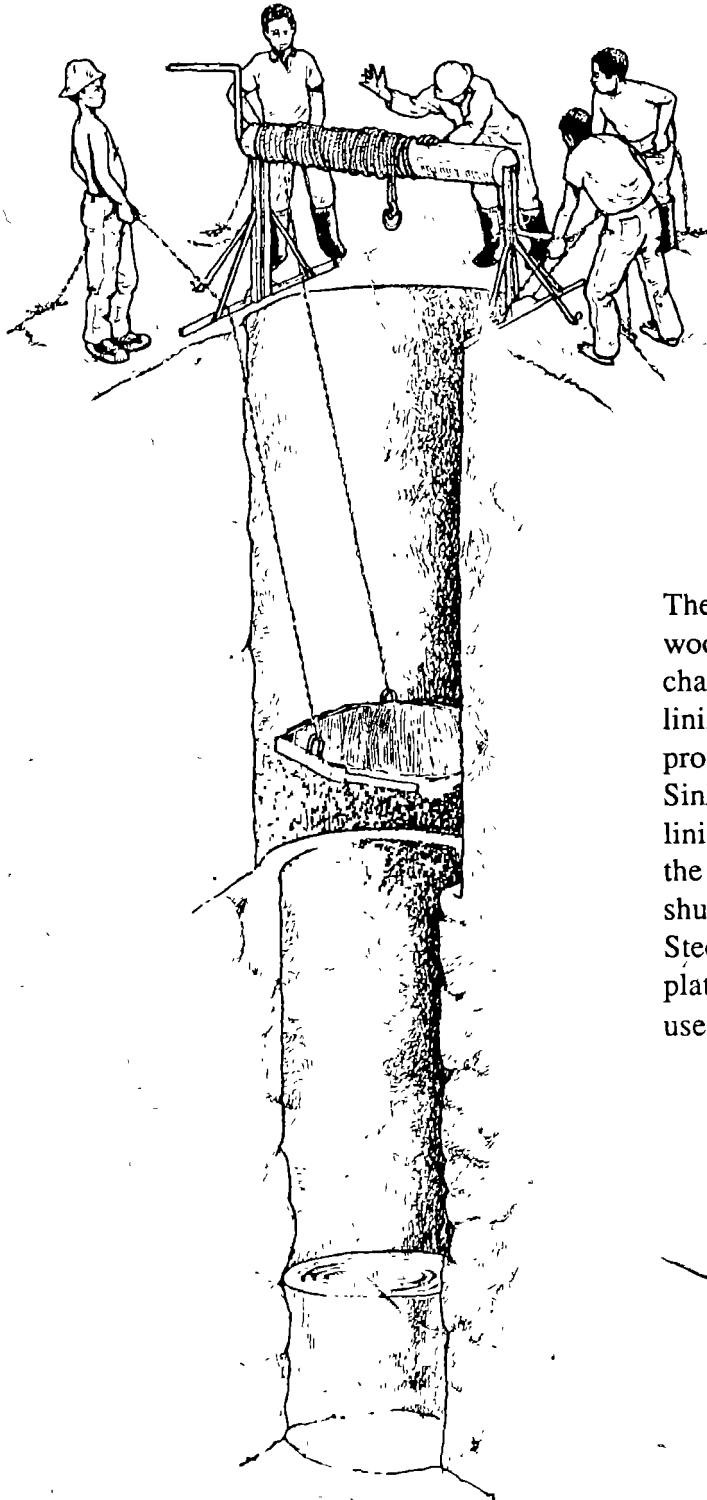
The lining shutters can be assembled **either** inside the well while standing on a working platform (see Step 2) or outside the well.



Check

- * The outside of the shutters has been oiled.
- * Use a spirit level to check that the steel lining shutter rests **level** on the foundation.
- * The space between the steel shutter and the side of the well is approximately 10cm all the way round. This space is filled with concrete to make the well lining.

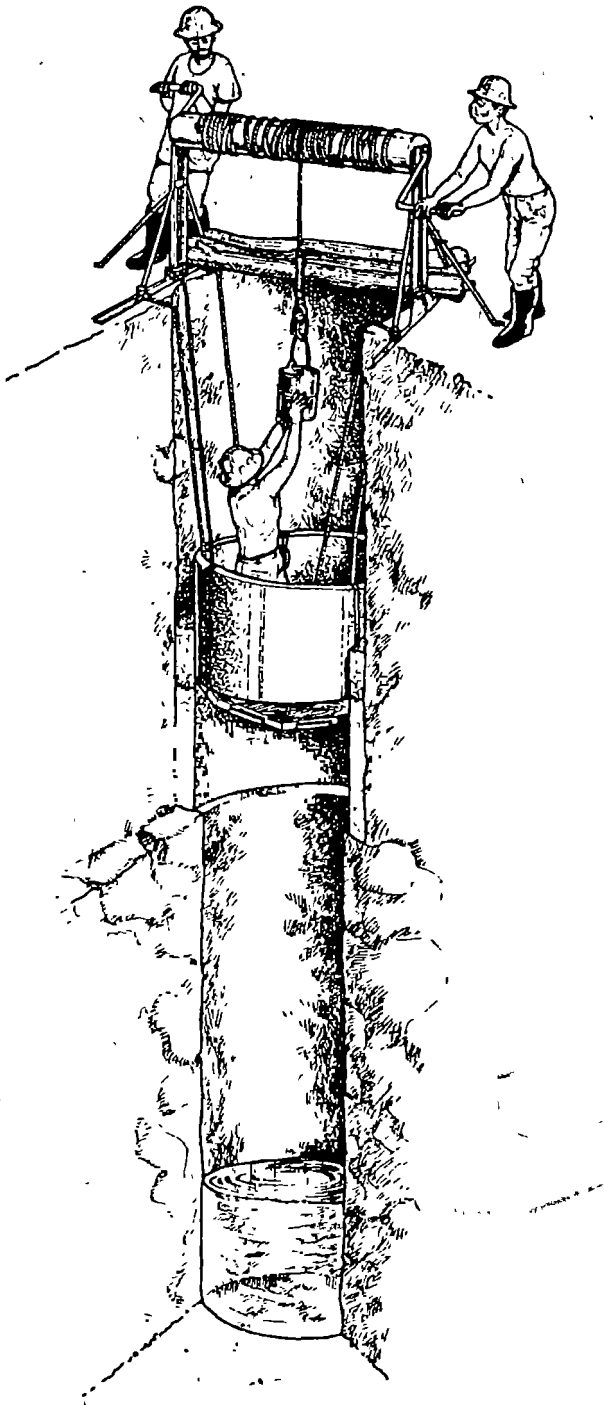
Step 2 Lower a working platform into the well



The working platform is made from either wood or steel. It is suspended by strong chains from the windlass, and fits inside the lining shutter. The platform provides a safe base from which the Well Sinkers can work when making the concrete lining. It is possible to lower the platform in the well either before or after the lining shutters have been positioned (see Step 1). Steel supports are placed across the base of the platform to prevent it moving about when in use.

Step 3 Mix the concrete and commence lining

Good concrete is the basis of good lining! Good concrete can only be produced by correct measurement and correct mixing



To do this

mix only enough concrete for one metre of lining.

For one metre of lining use

- * 2,5 bags cement
- * 4 wheelbarrows river sand
- * 8 wheelbarrows aggregate
- * water to mix.

To line the well

- * lower the concrete into the well using a builder's bucket.
- * pour the concrete carefully between the steel lining shutter and the side of the well.
- * use a rod to tap the concrete down firmly to remove air.
- * fill the gap until the lining reaches the top of the shutter. Leave it rough. This will allow for a good joint when the next layer of concrete is added.
- * leave for 1 day to allow concrete to dry. Remove lining shutters as for Step 4.

Important

When not in use, cover the concrete with a wet sack to prevent drying out in the hot sun.

Mix only enough concrete to complete one metre of lining at a time. It should be used within 2 hours

Do not

- * add water to old concrete mixes.
- * remix old concrete.
- * allow concrete to dry out during the lining process.
- * use too much water to mix the concrete as this weakens it.
- * use sand or stone which contains a lot of earth, clay or dust.

Step 4 Allow lining to dry

Allow the lining to dry for one day then release the lining shutters.

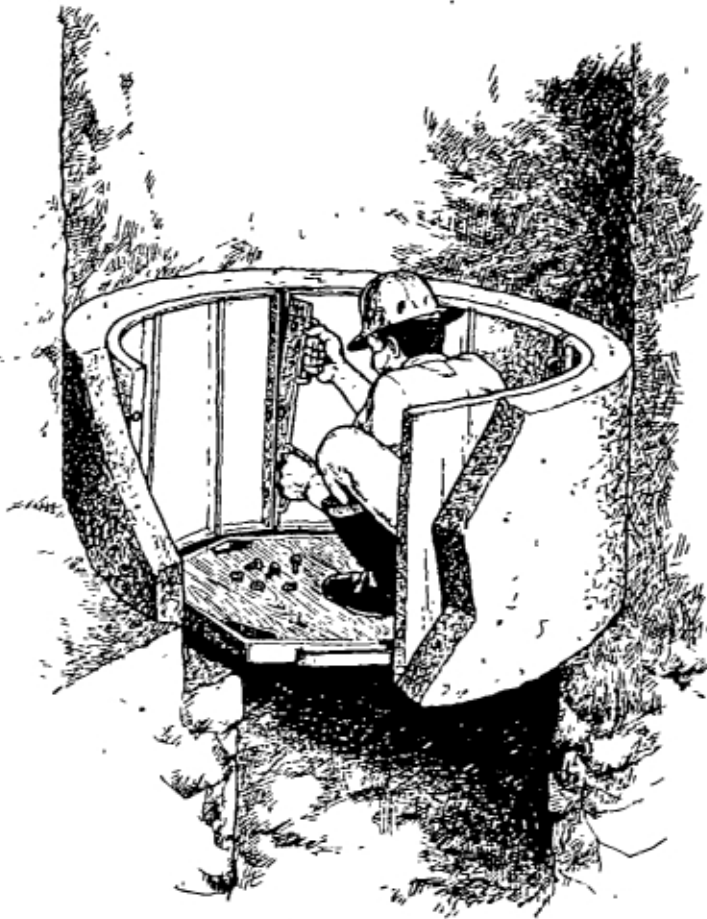
After one day

- * **loosen** the bolts of the lining shutters
- * **remove** the wedge keys from between the shutters
- * **pull** each shutter away from the concrete well lining
- * **lift** shutter pieces from the well with the windlass.

Remember to

- * **clean** the shutters carefully with a wire brush
- * **oil** thoroughly
- * **raise** the platform inside the well by one metre to the next level for lining by using chains
- * **re-assemble** the shutters (either inside or outside the well)
- * **re-position** the shutters carefully in the well and continue lining as from Step 3

Repeat this process until ground level is reached.



After one day remove
the lining shutters

Step 5 Make a raised collar

The concrete lining is constructed above ground level to make a 50cm raised collar. The collar * provides a strong foundation for the cover slab * prevents erosion of the well * prevents waste water draining into the well.

The finished height of the collar depends on the type of pump to be installed, ie
For the Nsimbi Pump or Well Type Bush Pump, the collar will be 50cm high.
For the Standard Bush Pump, the collar will be 10cm high.

To make a raised collar

- * remove the windlass
- * position the shutters carefully above the well
- * fill with concrete mix (use same mixture as for Step 3)
- * tamp down firmly
- * cover with wet sacks or wet sand and leave to dry for at least 1 day
- * loosen the shutters
- * remove the shutters carefully, clean, oil and store ready for use again.



Position the shutters carefully.

Remember!

- * Empty the well, remove rubbish and old concrete before placing the cover slab in Step 7.
- * Invite a member of the Health Team, i.e. a Health Assistant or Health Inspector to disinfect the well with chloride of lime (bleaching powder) before positioning the cover slab. *As a rule use half a cup of chloride of lime for every one metre of depth of water in the well.* This should be mixed with water and poured into the well. The well should not be used for 12 hours and then water should be pumped to waste until no chlorine smell remains.

Step 6 Make the cover slab

The cover slab is very important because it:

- * covers and protects the well
- * provides a strong foundation for the pump
- * prevents animals and children from falling into the well
- * is long lasting
- * is easy to build
- * can be easily removed if the pump breaks down.

For the Bush Pump which is likely to become standard in future, the cover slab is made in ONE piece and a short length of 150mm steel borehole casing cast into it. For the Nsimbi Pump and the Well Type Bush Pump, the slab can be made in two pieces. It is the latter case which is mainly described and illustrated here.

Materials needed to make one cover slab

Cement	1,5 bags
River sand	2 wheelbarrow loads
Stone aggregate	4 wheelbarrow loads
Foundation bolt 150mm long x 12mm diameter	4 in number
8mm diameter reinforcing wire	17,7metres cut as follows
	4 x 1,4metres
	2 x 1,25metres
	2 x 1.0metres
	5 x 0,65metres
	4 x 0,55metres
	1 x 0,45metres
	2 x 0,35metres
	4 x 0,25metres for handles

Extra equipment

Jig mould for pump foundation. This is especially designed for Well Type Bush Pumps and Nsimbi Pumps.

Set of steel shutters for moulding cover slab.

Preparations

Clean and level a place close to the well

Lay sand or plastic bags on the ground if possible

Estimate the diameter of the cover slab carefully. It will be equal to the diameter of the raised collar (i.e. 1,5m)

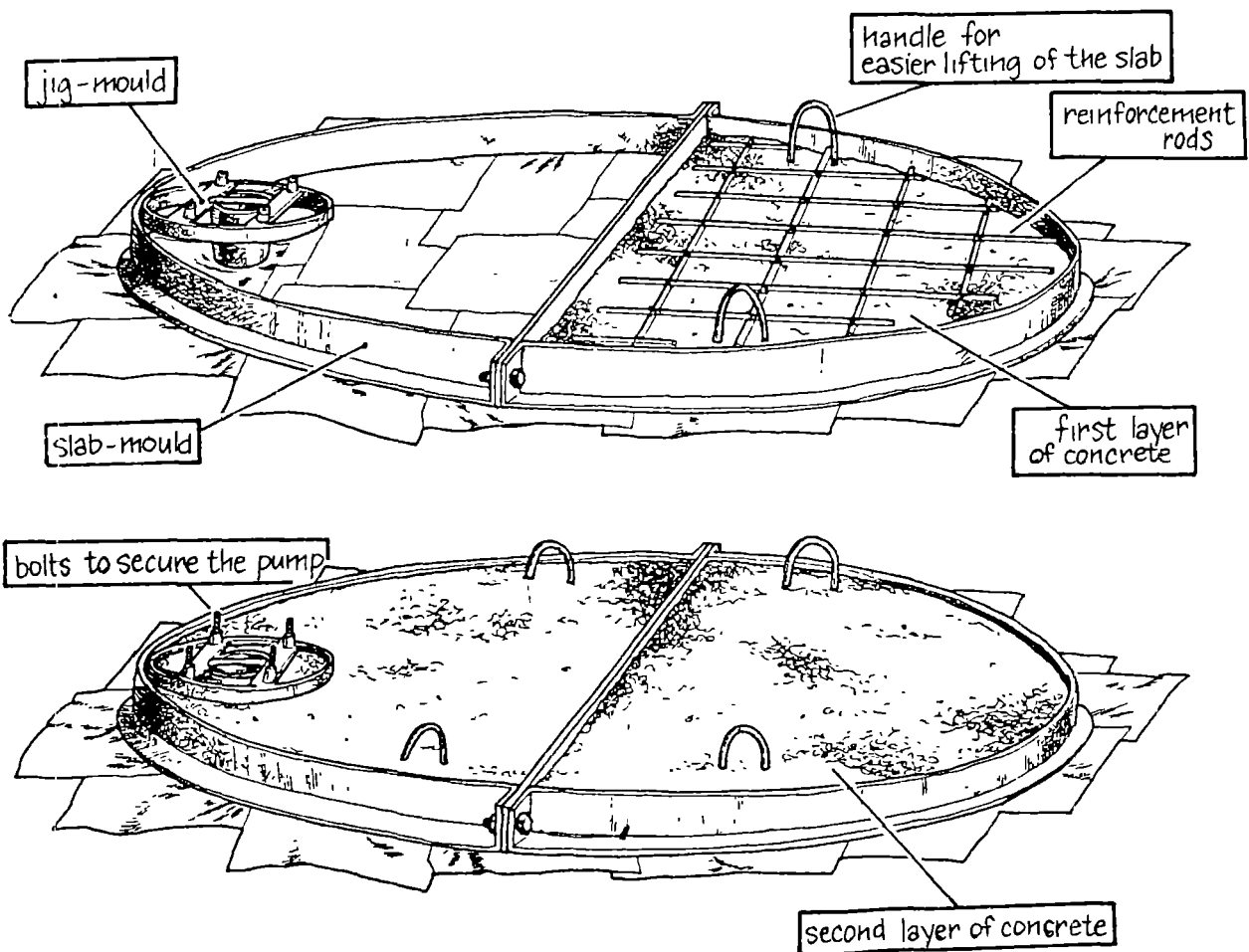
Use

Either an outside shutter provided by DDF

or bricks to mark the edges and central division of the slab if it to be cast in two pieces.

To make the slab

- * mix concrete using 1:2:4 mix
1.5 bags cement 2 wheelbarrows river sand
4 wheelbarrows concrete stones
 - * place 'Jig mould' after it has been oiled into one half of the top slab. This moulds a hole in the slab for the pump and locates the foundation bolts
For a Well Type BUSH PUMP, the Jig must be at the edge of the slab mould.
For a NSIMBI PUMP the hole for the pump must be 25cm from the edge of the slab mould.
 - * pour a layer of concrete into the mould (after it has been oiled)
 - * cut 8mm reinforcing rods to size. Lay 10cm apart inside the moulds and tie with wire
 - * bend pieces of reinforcing rod to make handles and tie to the other rods
 - * cover with concrete mix
 - * tamp down firmly
 - * cover with sacks which should be kept wet for 7 days to cure the concrete and make it strong. Loosen the 'jig mould' after 1 day
- The top slab should be 100mm (10cm) in thickness when completed.*



Step 7 Fitting the cover slab

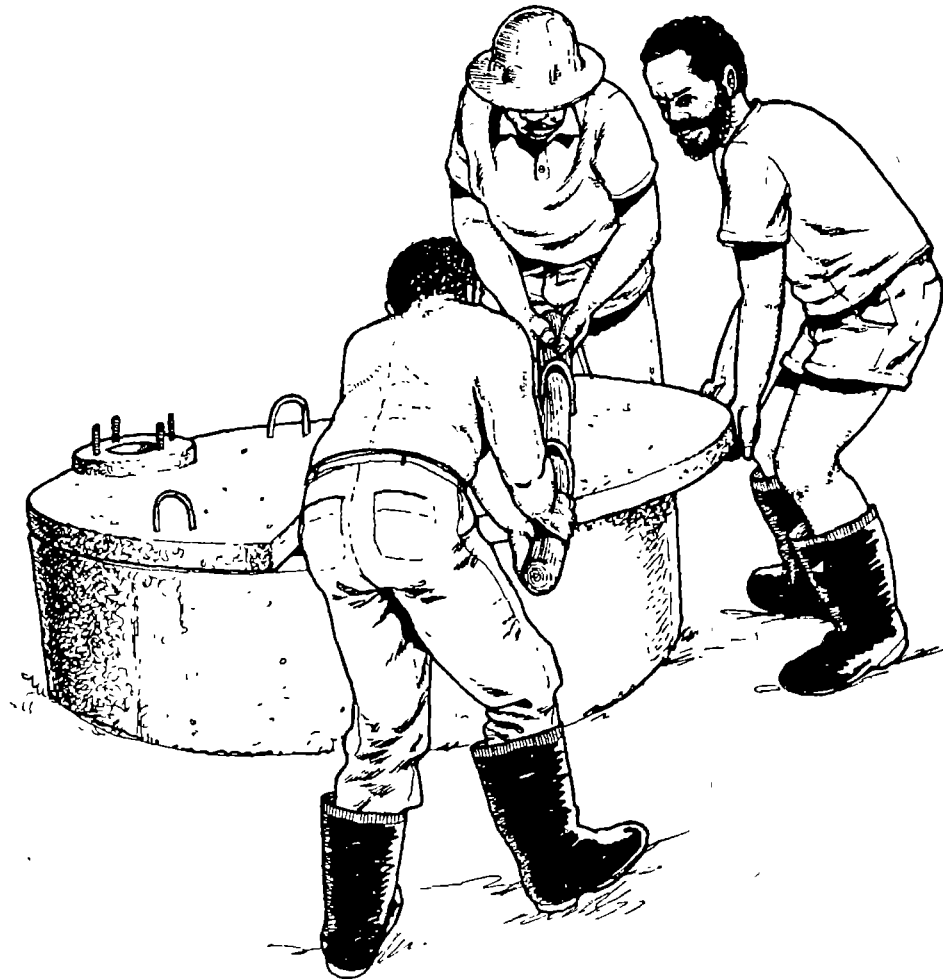
To fit the Cover Slab

Position the slab pieces onto the raised lining (collar) above the well.

Mortar into position above the collar.

Join the halves of the cover slab with cement mortar if it is made in two pieces.

Don't forget to clean the jig mould and shutters ready for the next use.

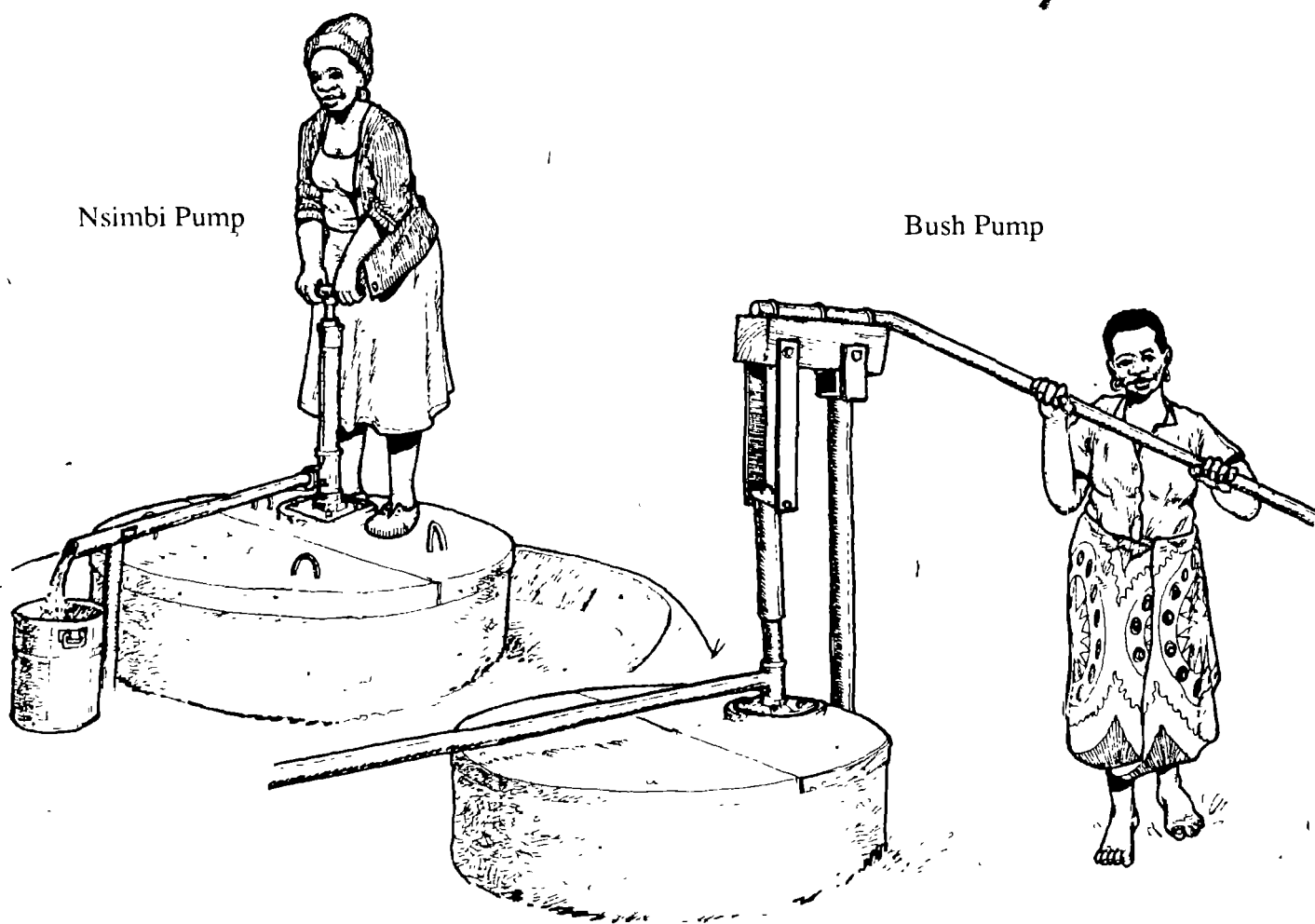


Step 8 Fit a suitable pump to the well

A number of pumps which are made in Zimbabwe can be fitted to wells. For shallow wells the Bucket pump, Nsimbi or Blair pump can be used.

For supplies which are deeper than about 13 metres, or if many users take their water from the well, then a Bush pump should be used. A number of different Bush pumps are available but it is likely that the type of Bush Pump which has 16mm pump rods, and bolts onto a piece of borehole casing will become the standard Bush pump in the future. If this type of Bush Pump is used then the cover slab will have to be made in one piece and a piece of borehole casing will have to be cast into the slab when it is being prepared. The layout is shown in Option A.

The Field Officer, in consultation with the community, will decide on the most suitable type of pump for the well.



Further information about fitting these pumps will be available in a series of pump manuals

Pump Manual No. 1: The Zimbabwe Bucket Pump

Pump Manual No. 2: The Zimbabwe Blair Pump

Pump Manual No. 3: The Standard Zimbabwe Bush Pump

Pump Manual No. 4: The Nsimbi Pump

Step 9 Make the drainage area

After the pump is fitted, a concrete drainage area is constructed. The drainage area is very important because it

- * helps to drain water away from the well and thus prevents pollution of the supply
- * provides a hygienic place for collecting water
- * is easy to clean
- * prevents erosion.

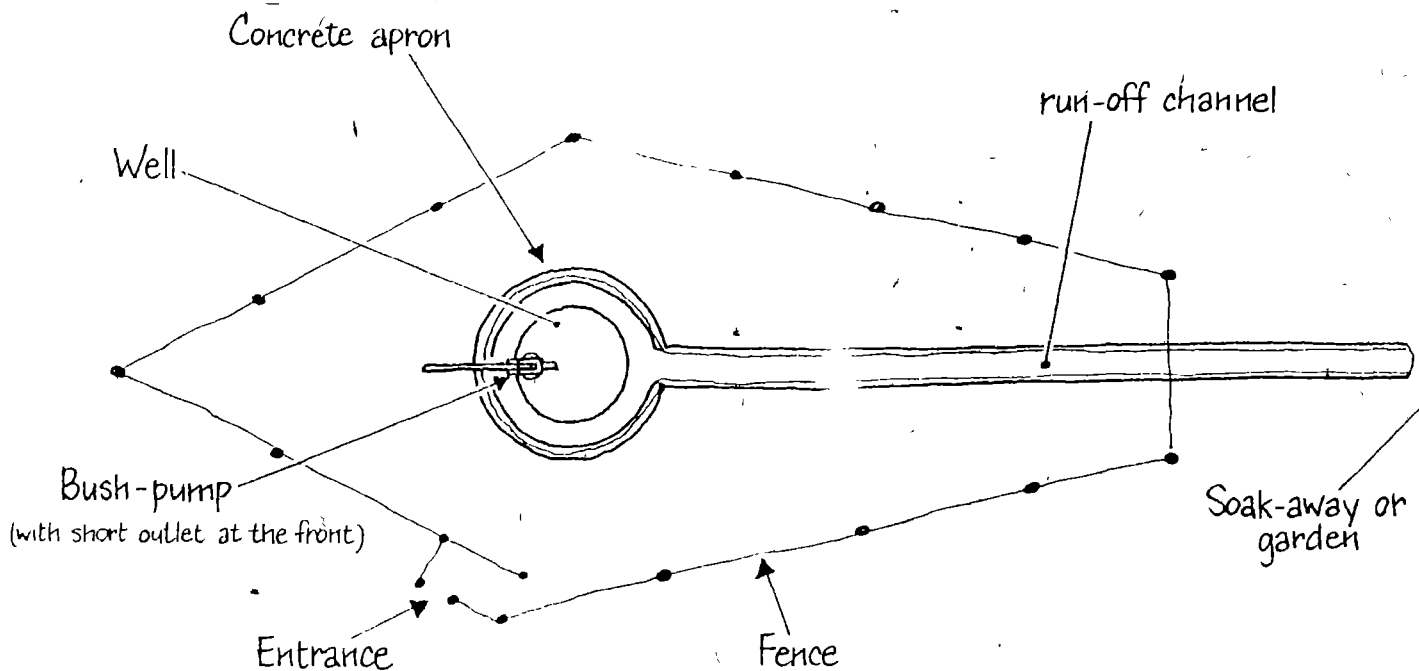
A drainage area may consist of one or both of the following:

- * a **concrete apron** where people collect water in containers
- * a **run off channel** which drains waste water away from the supply usually to a vegetable garden. Cattle troughs can also be built into the drainage area (Option C).

Drainage areas can be constructed in many different ways. Three examples follow.

Option A

In some projects, a 3m diameter concrete apron is built *around* the water supply and a 7 to 10m run off channel drains waste water away from the supply to a vegetable garden or soak away. (This technique is widely used in Ministry of Health supported projects).

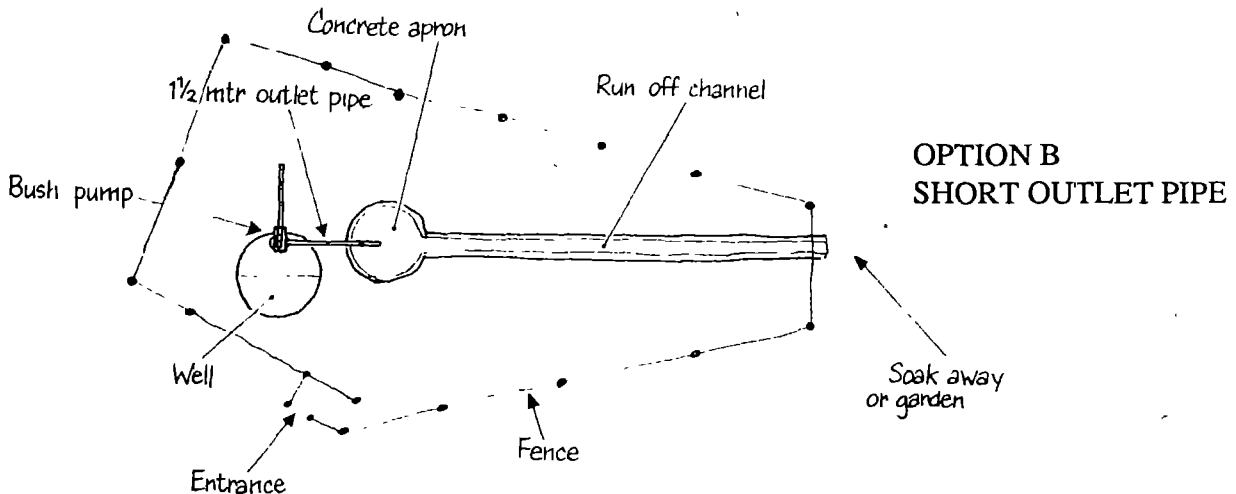


OPTION A

NOTE: The Pump is mounted on a short length of borehole casing concreted into the slab.

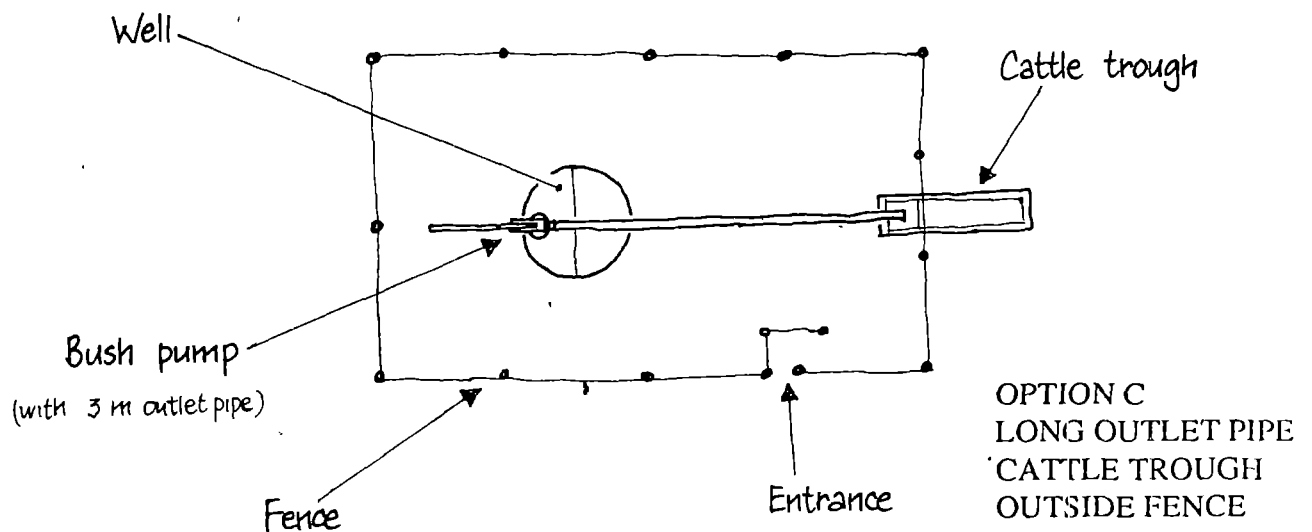
Option B

The pump is fitted as usual to the supply. It has a 1,5m outlet pipe. This extends across to the centre of a 1,5m diameter concrete apron where water buckets are placed for water collection. The concrete apron opens out to a 7 to 10m run off channel. The run off channel drains waste water into the vegetable garden. The area is completely fenced by the community with assistance from the DDF to prevent animals from fouling the area. A washing slab can then be constructed outside the fence and 10 metres from the supply to complete the project.



Option C

The pump is fitted as usual to the supply. It has a long 3m outlet pipe. The outlet pipe extends to a cattle trough which also has a bucket stand. The area is fenced off with most of the cattle trough outside the fence. The trough can be drained to a run off channel which drains waste water from the area.



To make the drainage area you will need

- * cement
- * stone aggregate
- * river sand
- * water
- * a set of well lining shutters or special apron shutters for Option B
- * a set of cattle trough shutters for Option C

To do this

Decide on the option in discussion with the community

Clear and level the site

Make the concrete mix (1:2:4)

Build according to the design i.e. the Option selected for the project.

Involve the community in this activity!

They can assist by

- * providing sand and stones
- * providing water for mixing concrete
- * mixing concrete
- * constructing the drainage area.

Complete the drainage area with a run off channel leading to a garden

The run off channel is very important because it drains waste water from the supply. It can lead to a vegetable garden or fruit trees.

To build the channel

Excavate a trench 30cm wide. Depending on the length you want

make concrete using

1 part cement

2 parts sand

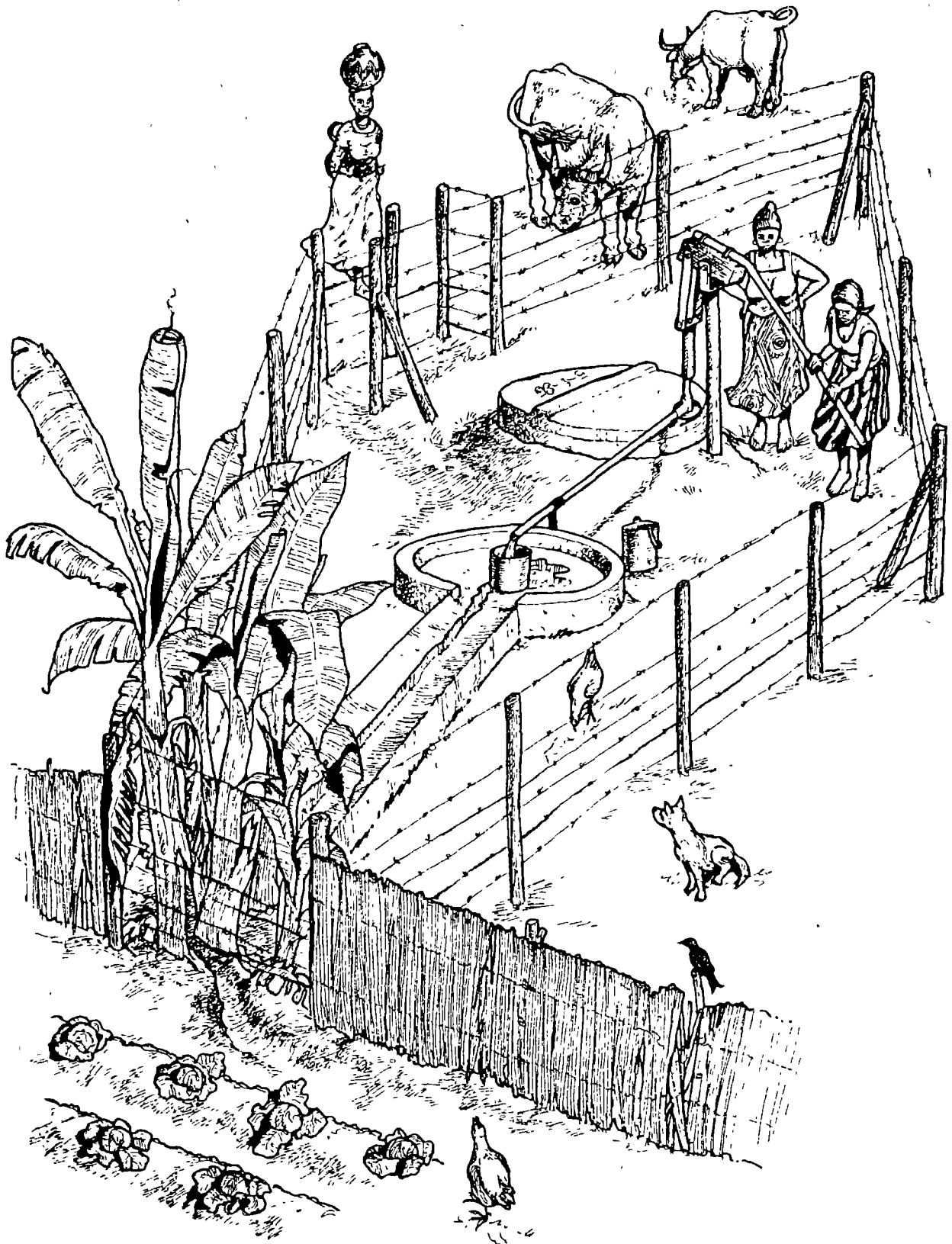
4 parts stone aggregate.

lay concrete in the trench to make a finished run off channel 160mm wide. In some projects a wooden mould is used to shape the channel.

leave to dry for at least one day before use.

Involve the community in this activity too!

Option B
Completed project with Bush Pump and Short Outlet Pipe



Step 10 Fence the water supply

A new project is only complete after it has been fenced. The fence is important because it protects the water supply from animals.

Although materials for fencing are often provided by project funds, the community should be involved and assist in the fencing activities.

Depending on the design, the following materials should be collected

* cement and river sand * corner posts * fence posts * barbed wire enough for 6 strands (1 roll is usually enough for 3 projects).

To make the fence

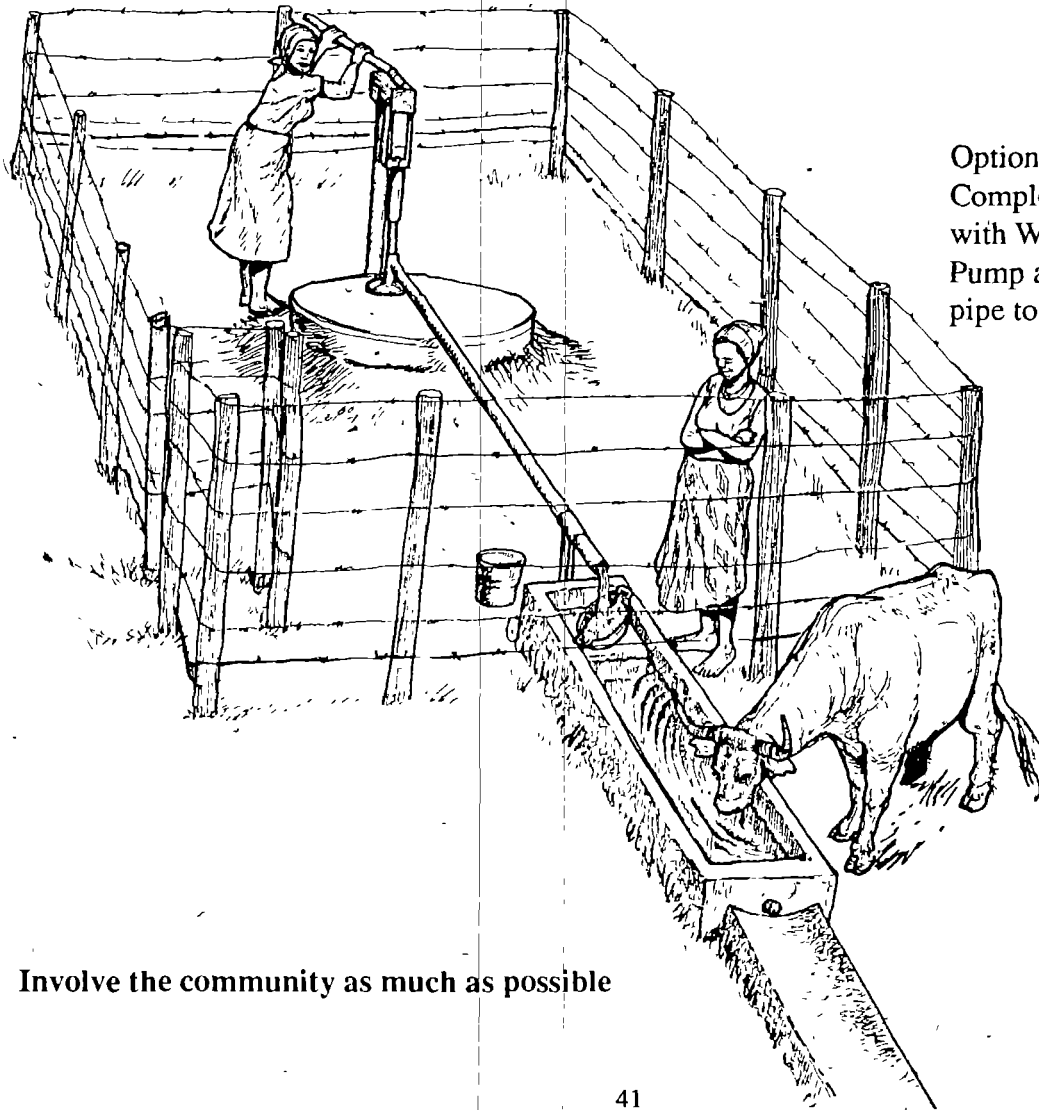
mark out the area carefully

dig the holes for the fencing poles (i.e. 90cm deep) so that each pole will be 1,5m above ground

position the poles upright in the holes

pack concrete *round* the poles

stretch 6 strands of wire around the poles



Option C
Completed project
with Well Type Bush
Pump and long outlet
pipe to cattle trough

Involve the community as much as possible

Complete the project with a washing slab

A washing slab provides a hygienic and safe alternative to the river for laundry purposes. If project funds are sufficient a washing slab should be built at the site of the new supply. There is a standard design which builders can follow (see diagram).

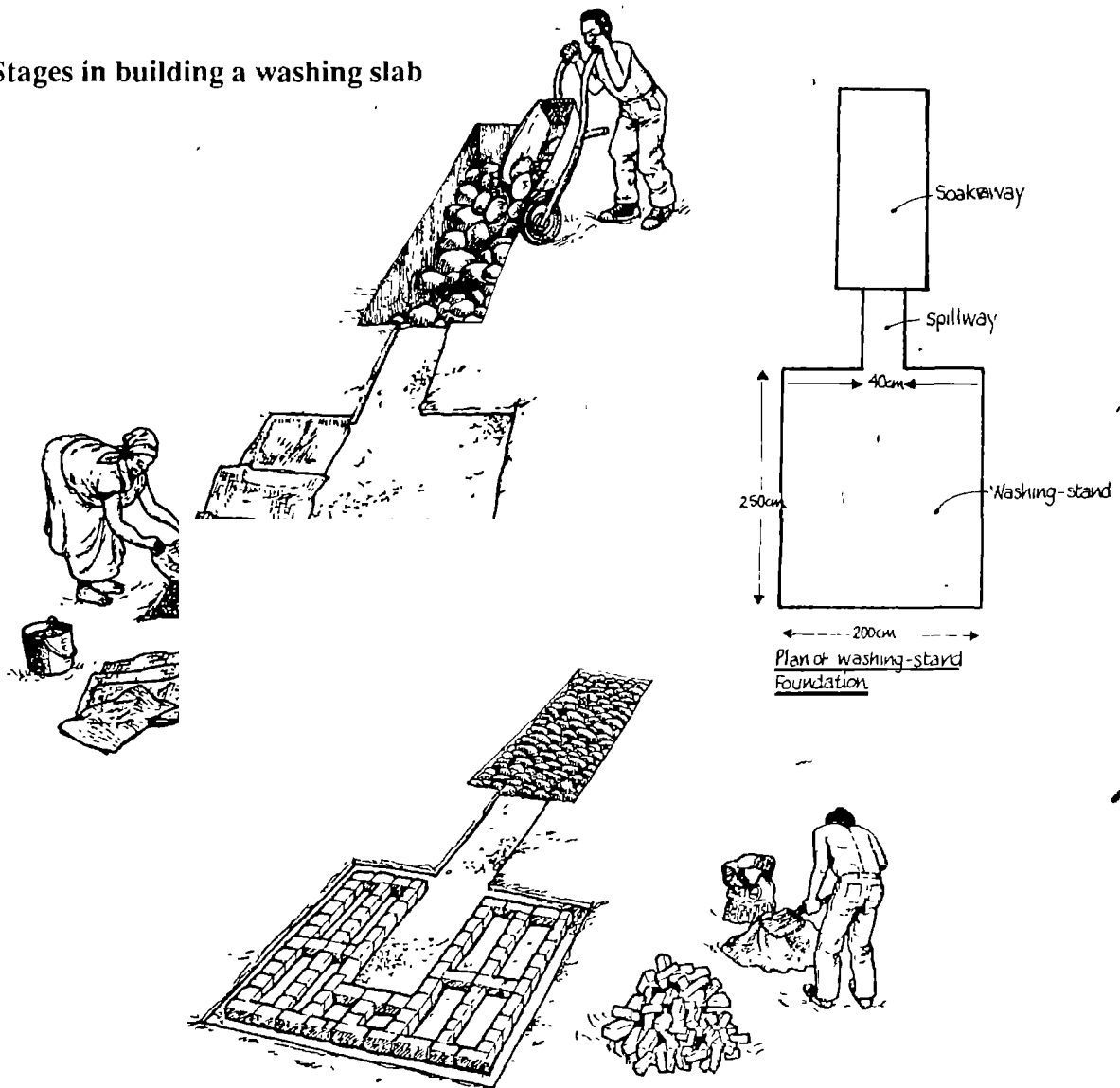
The washing slab should be sited outside the fence 10 metres from the well and to one side so that waste water cannot seep back into the well.

To build the slab

collect the building materials. You will need 800 bricks 7 bags cement River sand Stone aggregate Steel or PVC piping for the outlet pipes.

clear the area lay the foundation build according to instructions!

Stages in building a washing slab

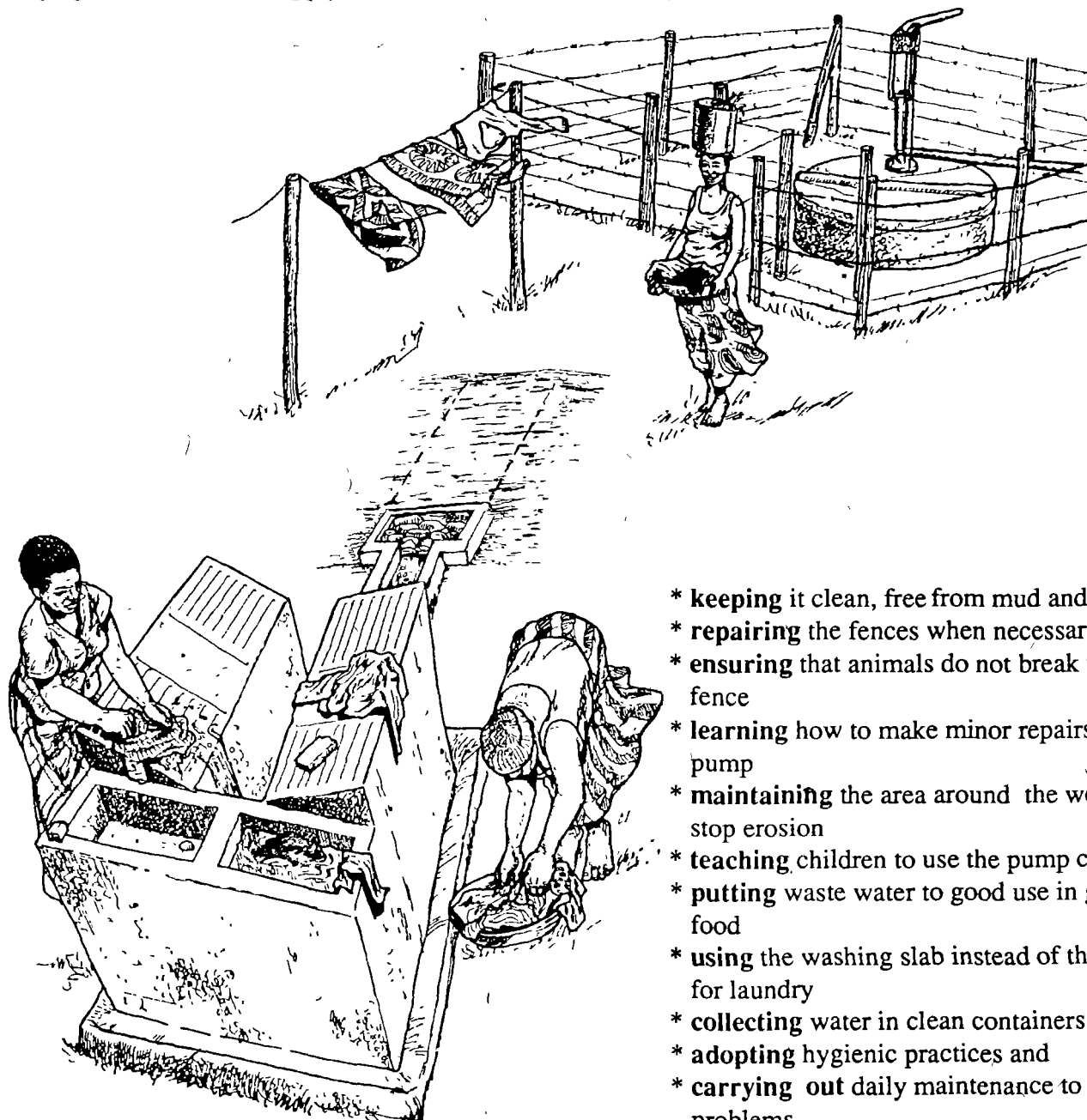


Involve the community in this activity; they can provide material and assistance with building the washing slabs.

PART THREE

Hygiene and maintenance of the supply

It is usual for communities to celebrate the completion of their new supply! Such occasions also provide a good opportunity to share information about the need to maintain and use the supply hygienically. The Village Water Sub-Committee can play an important role in encouraging the users of the supply to **take pride in their well**, by



- * **keeping** it clean, free from mud and rubbish
- * **repairing** the fences when necessary
- * **ensuring** that animals do not break the fence
- * **learning** how to make minor repairs to the pump
- * **maintaining** the area around the well to stop erosion
- * **teaching** children to use the pump correctly
- * **putting** waste water to good use in growing food
- * **using** the washing slab instead of the river for laundry
- * **collecting** water in clean containers
- * **adopting** hygienic practices and
- * **carrying out** daily maintenance to prevent problems.

The Village Water Sub-Committee should select a Pump Caretaker to be responsible for daily pump maintenance



PART FOUR

APPENDICES

- APPENDIX A** **Sample Constitution**
- APPENDIX B** **Well sinking equipment needed for one well sinking project**
- APPENDIX C** **Community well digging project contract**
- APPENDIX D** **Community well digging: well record form**
- APPENDIX E** **Application for authority to convey explosives**
- APPENDIX F** **Application for a Restricted Blasting Licence**
- APPENDIX G** **Permit to Purchase, Acquire and Possess Explosives**
- APPENDIX H** **Licence for Storage of Explosives**



SAMPLE CONSTITUTION

THIS CONSTITUTION SETS OUT THE DUTIES AND OBLIGATIONS OF VIDCO MEMBERS, VIDCO WATER SUBCOMMITTEE MEMBERS AND VILLAGES WITH REGARD TO THE WATER SOURCE.

THE NAME OF THIS VIDCO WATER SUB-COMMITTEE IS _____

1 AIM

The aim of the Committee with regard to the community water source is to organise and manage local contributions towards the construction, care and maintenance of the water source and its surrounds, and to organise community members to obtain maximum use and benefits from it.

2 MEMBERSHIP

All households which are to benefit from the water source must be represented by the VIDCO Water Sub-Committee which may however have to report to more than one VIDCO.

3 RESPONSIBILITIES

The right of any member to draw from the handpump will be determined by the following:

- A. Members contribute their full share of labour towards the construction, care and maintenance of the water source and its surroundings.
The Committee will decide upon and organise each member's work.
- B. The VIDCO shall decide how to discipline those members of the community who do not contribute labour without good reason.
- C. New households should be informed of their responsibilities prior to usage.

4 ELECTIONS

Election of VIDCO Water Sub-Committees should be in accordance with election of VIDCOs. Once every 2 years a general meeting of all members shall elect a committee which will serve for 2 years and consists of at least 4 people, one of whom will be the Pump Caretaker - usually a woman. A minimum of 2 members shall be women. The Village Health Worker shall be coopted on to the committee in an advisory role. The presiding officer for the election shall be the WARDCO Chairman or VIDCO Chairman assisted by the Village Health Worker. The old committee members shall show their successors how to carry out their duties, and help whenever necessary. All resolutions of a general meeting must be passed by a majority of those present. Each adult present shall have one vote.

5 REMOVAL FROM OFFICE

At any time during office, any committee member may be removed from office and replaced at a general meeting (without prejudice to his/her use of the water source) if:

- A He/she is prevented from work by illness or absence.
- B He/she fails to attend three consecutive committee meetings without good reason.
- C He/she resigns
- D The members are not satisfied with him/her and give good reasons for his/her removal.

6 MEETINGS

The committee shall meet at least once every month when the appropriate committee members will report on the state of the water source. Any committee member can call a committee meeting, but must give several days notice, except for urgent matters. All committee resolutions must be carried by a majority members vote.

7 POWERS AND DUTIES

- A. If the VIDCO Water Subcommittee is formed during a well digging project then the first task is to organise the community to participate in the siting and digging of the well as specified in the contract.
- B. To arrange for the members of the community to help build or repair the handpump surrounds as the committee may decide.
- C. To report to the VIDCO, WARDCO or Police as appropriate, anyone found wilfully damaging the handpump or surrounds or interfering with the committee's work.
- D. To pass on any requests of the committee to the VIDCO.
- E. To report to the VIDCO any disagreements which the committee are unable to resolve.
- F. To be responsible with the VIDCO for organising the allocation of irrigated garden or orchard sites and/or the distribution of produce.
- G. To organise a regular roster of members' responsibilities for cleaning and sweeping the handpump surrounds.
- H. To be responsible when necessary for ensuring that members adhere to any water use restrictions imposed by the committee which may be necessary in time of drought.
- I. To supervise the work of the volunteer pump caretaker and to arrange with the VIDCO for cash collections from the community members to compensate her for any expenses.
- J. To arrange with the VIDCO for cash collections from the community members to buy grease or other items needed to maintain the pump.
- K. To arrange for members of the community to assist DDF with handpump repairs.

8 POWERS AND DUTIES OF THE PUMP CARETAKER

- A. To look after any tools supplied to the VIDCO for maintenance of the handpump.
- B. To maintain the handpump in good working order by tightening bolts and greasing as required.
- C. To report damage, breakdown, reduced flow or unusual noise of the handpump to the DDF maintenance camp.

9 LIABILITY

Community members agree to participate in these activities entirely at their own risk. Neither the Government of Zimbabwe nor any of its employees will be liable for any injuries or accidents howsoever caused and no compensation will be payable.

Well sinking equipment needed for one well sinking project

Item No.	Item	Quantity
1	Windlass	1
2	30m wire rope	1
3	Thimble	1
4	Crosby clamp	3
5	Tumbler hook	1
6	Mining bucket 50 litres	1
7	Miner's bar 1,5m	1
8	Shovel, round nosed, short handle	2
9	Pick short handle	2
10	Mattock	1
11	Sledge hammer	1
12	Drill steels 0,6m long	2
13	Drill steels 1.0m long	3
14	Hammer 4lb	2
15	Water bucket	1
16	Wheel barrow	1
17	Mining hat	4
18	Rubber boots (pairs)	4
19	Explosives box	1
20	Tin grease	1
21	Shifting spanner (10inch) 250mm	1
22	Plumb line	1
23	Tape, 3 metre measuring	1

Concreting equipment (needed at well site during concreting)

Item No.	Item	Quantity
1	Wooden or steel platform including chains	1
2	Shutters, inside 1m high, set	1
3	Shutters, outside 0,5m high, set	1
4	Bucket, builders	1
5	Trowel	1
6	Spirit level	1
7	Oil can	1
8	Fencing pliers	1
9	Hacksaw and blades	1
10	Wooden float	1
11	Cold chisel	1
13	Slab shutter 1.5m diameter x 0.1m high in two halves - set	1
14	Jig mould for pump foundation	1
15	Wire brush	1
16	Cattle trough shutters, set	1
17	Special apron shutters, set	1

ZIMBABWE GOVERNMENT
COMMUNITY WELL DIGGING PROJECT

SAMPLE CONTRACT

BETWEEN VILLAGE DEVELOPMENT COMMITTEE
OF WARD
OF DISTRICT
AND WELL SINKER

FOR CONSTRUCTION OF A WELL AT

The well will be circular and have a diameter of 1,5 metres in soil and 1,2 metres in rock. The bottom of the well will be at least 2,0 metres below the water table. The well cover slab will be made of reinforced concrete, 10cm thick. In collapsing ground precast concrete rings will be used.

The Community agree to:

- 1 Start digging the well after the site has been approved by DDF, with a diameter of 1,5 metres down to rock or depth of 3 metres whichever is first reached.
- 2 Provide accommodation and assistance with food for the well sinker and for his labourers for the period of construction after the community digging is completed.
- 3 Provide clean broken stone and sand for concreting the well lining, cover slab and headworks
- 4 Witness the removal of water from the well to check that work is not stopped before 100 mining buckets are obtained on two successive days. (i.e. 100/day)
- 5 Provide a layer of stones around the well to protect against erosion.
- 6 Construct a fence around the well.
- 7 Look after the well and handpump and ensure that they are properly used and maintained.
- 8 Transport the well sinking equipment from site to site.

The Well Sinker agrees to:-

- 1 Abide by the instructions and decisions of the DDF Field Officer or his assistant who can stop the work or cancel this contract at any time and who will see that the work is properly carried out and the site chosen suitable.
- 2 On completion of the community digging engage labourers and complete the well as quickly as possible for the following rates of pay given in dollars per metre of well sinking depth.

Depth and water allowance	Soil	Decomposed Rock	Solid Rock
<u>0-15 metres deep</u>			
No water	14	24	36
10-25 buckets per day	17	27	40
26-60 buckets per day	21	31	47
more than 60 buckets per day	27	37	54
<u>More than 15 metres deep</u>			
No water	23	33	43
10-25 buckets per day	29	39	49
26-60 buckets per day	37	47	57
more than 60 buckets per day	49	59	69
Lining \$15 per metre			
Lining under water \$22 per metre			
Making and fitting cover slab \$15			

Note:

- i) The DDF Field Officer will decide on the rates applicable and measure the work done, normally on a monthly basis.
 - ii) DDF may decide to exclude the cover slab from the contract
- 3 Continue sinking until at least 100 mining buckets full of water are removed from the well on two successive days (i.e. 100/day)
 - 4 Be responsible for and use with care the equipment and supplies issued to him by the DDF Field Officer which should only be used for construction of the well and to re-imburse the cost of missing items.
 - 5 Maintain at his own expense a bicycle if issued with one.
 6. Ensure the well is adequately protected from animals and children during the construction period.
 - 7 Adhere to all safety regulations concerning blasting and well digging.

.....
WELL SINKER (signed)

.....
SECRETARY - VILLAGE DEVELOPMENT
(signed)

Approved by:
DISTRICT ADMINISTRATOR

Date:

Note that the rates referred to in the table above may change from time to time.

ZIMBABWE GOVERNMENT - COMMUNITY WELL DIGGING PROJECT
WELL RECORD FORM

District	Serial Number
Ward	Grid reference Map No.
Village	Name of Well
Community	Depth of Well
Water Committee Members	Water Column
1	Number of Users Date
2	Name of Well Sinker
3.	
4.	

Date	Excavation & Lining in m			No. of buckets of water per day	Rate per Metre	Amount	Total Due	Received
	From	To	Material or lining					

Details of Pump	Materials Used
	Explosives
	Cement

Remarks



OFFICE OF THE INSPECTOR OF MINES & EXPLOSIVES
P O BOX 8009
CAUSEWAY

EXPLOSIVES TO BE IN CHARGE OF AUTHORISED PERSONS WHILE BEING CONVEYED
EXPLOSIVES (CONVEYANCE AND LOADING) REGULATIONS 1970

In terms of section 4(1)(b) (as amended of the above regulations),

.....
is hereby authorised to convey explosives by road on behalf of

.....
Route:

.....
Issue Date Expiry Date

INSPECTOR OF EXPLOSIVES



Form E.L.U.

EXPLOSIVES (LICENSING AND USE) REGULATIONS, 1970

APPLICATION FOR A RESTRICTED BLASTING LICENCE

Fee: \$2,50

TO

(Application to be addressed to the Inspector or Sub-Inspector of explosives of the mining district in which the applicant resides)

I,
(full names)

hereby apply, in terms of section 10 of the regulations, for a restricted blasting licence to carry out the blasting operations detailed hereunder:

.....
.....
.....
(specify type of blasting operations involved)

at
(specify place at or area within which it is desired to undertake blasting operations)

during the following period

Date of birth

Residential address

Postal address

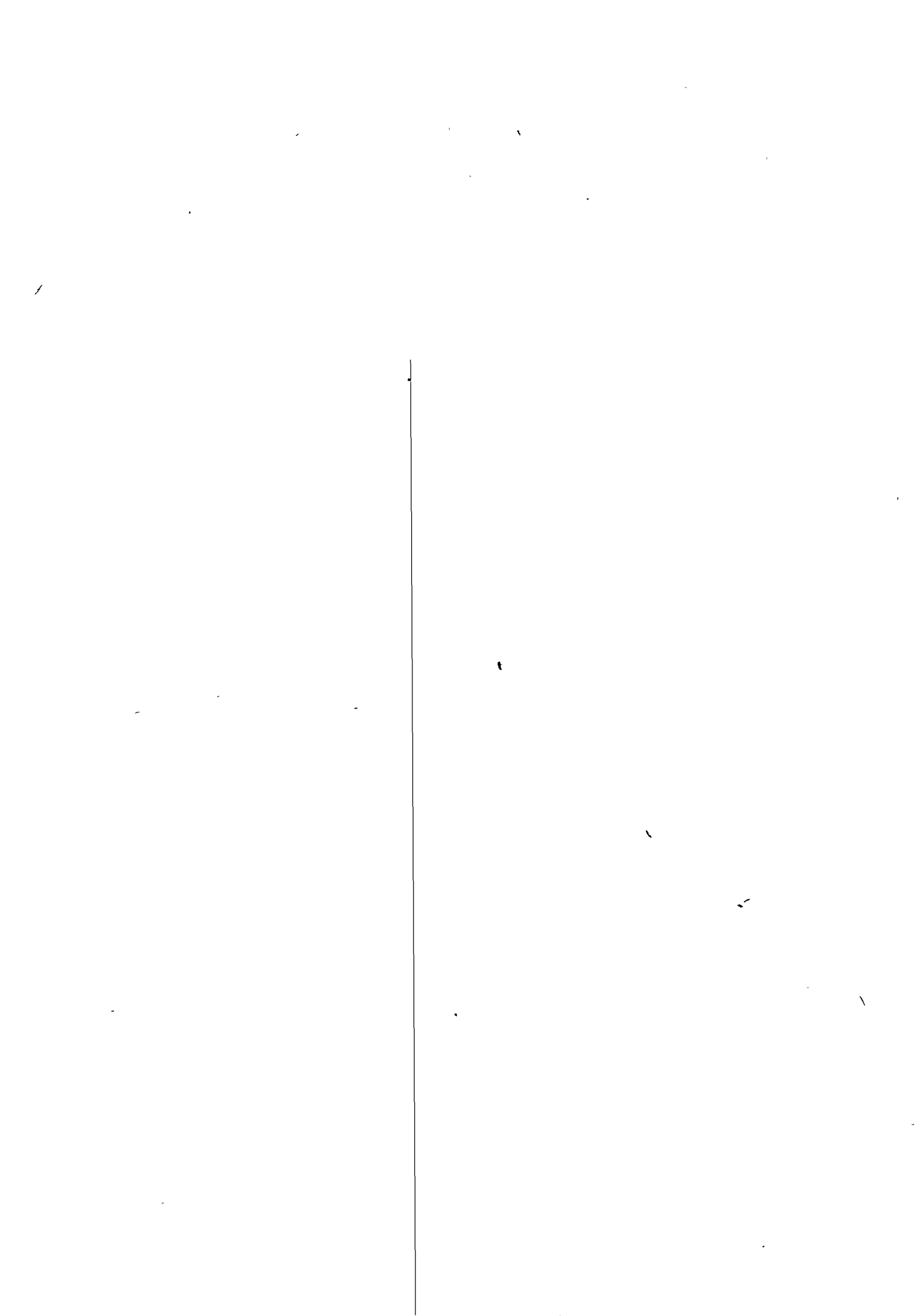
Blasting experience

Present employment

Signature
or right thumb print of applicant if unable to sign

Date

- Note: 1 A restricted blasting licence may not be granted for use in blasting operations on a mine unless the applicant has had at least 80 shifts underground experience, of which at least 20 shifts have been at the place at which blasting operations are conducted.
2 A restricted blasting licence may not be granted to a person less than 19 years of age.



ZIMBABWE

EXPLOSIVES (GENERAL) REGULATIONS, 1970

**Permit to Purchase, Acquire and Possess Explosives
(not transferable)**

Permission is hereby granted to

of

.....

to purchase, acquire and possess the following explosives:

(1) Nature of explosives	(2) Maximum quantity that may be possessed at any one time not to exceed	(3) Total amount which may be purchased under this permit
Fracture explosives		
Cordtex		
Safety fuse		
Igniter cord		
Detonators		
Electric detonators		
Connectors		
Fuse igniters		
Capped fuse		
Others		

(4) Intended use of explosives

at

(5) Place where explosives are to be kept

.....

Station

Inspector/Sub-Inspector of explosives

Date

Signature of holder

THIS PERMIT EXPIRES ON THE 30TH JUNE, 198...

APPE
No.....

ZIMBABWE

LICENCE FOR STORAGE OF EXPLOSIVES

Licence is hereby granted to:

.....

of

to store explosives at

in the district of

Subject to the conditions set forth hereunder or attached hereto.

This licence is valid from:

This licence expires on the

.....
Inspector of Explosives

Date

CONDITIONS

1 Only the types of explosives specified in column A shall be stored in the places specified opposite thereto in column B in quantities which do not at any time exceed the amount specified opposite thereto in column C.

Type of Explosives	Storage Place	Maximum Amount
A	B	C

