Work with Water

- A Guide To Careers -

with Water, Waste Water and Environmental Protection

Published by the Government of Botswana
Ministry of Education
Guidance & Counselling Division
Gaborone 1994

Acknowledgements

This book is a valuable contribution to career guidance in Botswana. It focuses on a specific area of need, the water sector. The sector is addressed from a gender perspective and this approach should yield positive results not only in terms of Batswana taking scientific and technical jobs, but also through increased participation of women in the sector.

The Ministry of Education is indebted to SIDA which provided financial support through the Botswana Government - SIDA Culture and Education Sector Support Programme. SIPU offered technical support through a consultancy. Bengt Carlsson (SIPU consultant) and members of the project group did an excellent job in the production of the book.

Members of the Reference Committee are thanked for the reviews and for providing overall direction of the project. Their contributions added quality to the final output.

The guidance teachers, students and water sector professionals involved in the project are thanked for providing the information and support for the production of the book. Their contributions have made the contents relevant to Botswana, a product which was tested and passed by the target audience - the students.

It is the hope of the Ministry that this approach to writing, where everyone was involved from planning the story board to the end was also a training experience. This should leave those involved with skills to develop materials. Indeed there is need for much more information if Botswana youth is to be prepared for the competitive world of work.

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Contents

This book is about three very important things. It is about water in Botswana – how to find it, how to use it, how to keep it clean. It is also about careers – what jobs (with water) are going to be available for you, a secondary school student, when you complete your studies. Finally, it is about the need for both women and men in these jobs. There are some beliefs that women and men can not do the same types of work. These beliefs are not true. There is a great need in Botswana for both women and men who have technical knowledge and who are responsible and serious about their work. At present, there are more men in technical jobs. Unless women also help, there will not be enough people to take care of Botswana's most precious resource – water.

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"I am from Ghanzi. People in the surrounding area have a problem with water. They sometimes make use of water from the pans. This water is not always available and it is often not safe to drink. The bore hole drillers are private people. They are not always available. If I can get training as a Water Engineering Technician, it will be an advantage for the people."

– quotation from Ms. Annah Kambura, student at the Botswana Polytechnic, December, 1993

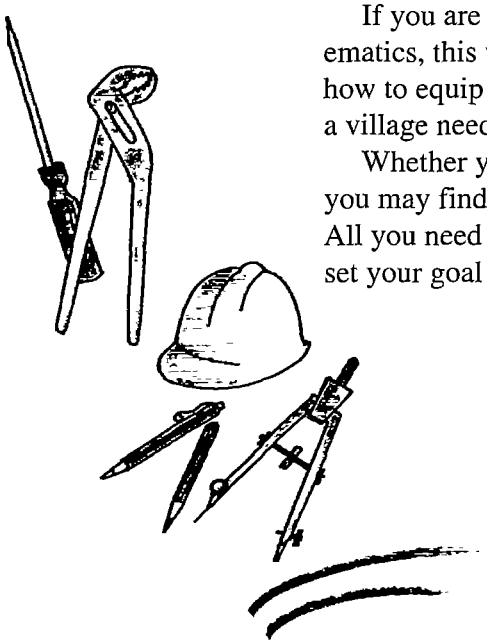
Choosing a Career

Choosing a career is not easy when you do not have enough facts. Some people say that certain jobs are for men only, and other jobs are for women. The truth is that there are many different types of jobs, and if you are good at mathematics and science, you have an advantage because there is a very great need in Botswana for people with those skills. It does not matter if you are male or female - what is important is that you have the skills, the knowledge and a good attitude to your work.

Careers which deal with management of water (careers in the "water sector") can be very interesting. Clean water is important for both human beings and livestock. Proper disposal of waste water and solid waste is part of this process, because if it is not done properly it can make the water dirty.

If you are good in science and mathematics, this will help you understand how to equip a bore hole or decide what a village needs for its water supply.

Whether you are a man or a woman, you may find a career which suits you. All you need is enough determination to set your goal and go for it.



Water technicians are trained in the basics of surveying and levelling. Skills in these areas are important in the water sector

WET Students Said:

Before this book was written, a group of students at the Botswana Polytechnic met to discuss some of their ideas about their jobs and the course they were taking. The course is called Water Engineering Technicians Diploma Programme - or WET.

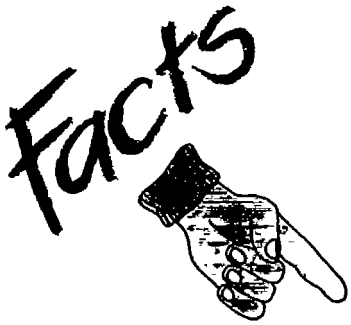
A woman at the meeting said:
"I am an employee of the Department of Water Affairs (DWA). After the present course, which is to last for two years, I will go back to DWA for practical work. I enjoy working out in the field and would like to continue doing that as a waste water manager. The only difficulties I have are with technical drawing, because I have not had any previous training in that. But I believe I will be able to learn it, if I work hard."

A man said:
"I completed the Pre-Entry Science Course (PESC) at the University of Botswana before starting the WET course. I also like working outdoors. I want to become an environmental engineer, eventually. I enjoy the course. I have no difficulties with the subjects. However, I did not know there would be so many subjects in this course. For example, I did not expect to learn surveying and map reading, building construction and drawing, and computer awareness. I thought the course was just about water and waste water, only."

Another woman added that she had heard about jobs in the water sector when she was doing her Tirelo Sechaba.
"I got information about it from a friend. My goal is to become an environmental engineer. I want to help prevent diseases that can be spread through pollution of the water supply or poor quality of water."

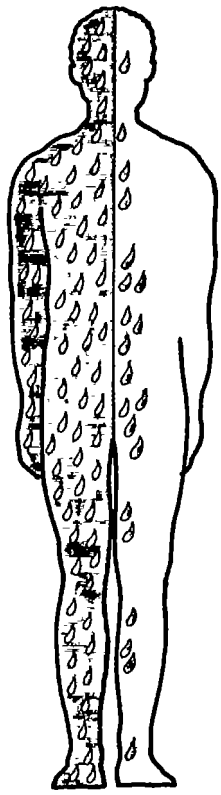
Another man explained that he works for a district council. He said:
"I have had in-service training. I have experience in bore hole maintenance. I would like a career as a water engineer, because I have seen the hardships that come when there is a problem with the water supply at the cattle post. I do not see any problem for women in this type of work. The women in this course work very hard and are very much committed. That is what is important, in any job."

What is important in any job is a person's commitment to the job. Both women and men can show commitment and responsibility in their work.



Water for Life and Development

Water makes up seventy per cent of the human body. We can live for weeks without food, but only a few days without water.



There is nothing as wonderful as water It is an absolute necessity for life Life on earth started in water and the chemistry of life still takes place in water More than 70% of your body is water 90% of your blood is water To stay healthy you must drink water more than five times your own weight in a year We share the same water with all living creatures on earth

Water is in all of our body parts. The water we drink flushes out the body's waste products which otherwise would poison us. Even our lungs need water, because if they are not moist, we can not absorb the oxygen which we need from the air.

We can live for weeks without food, but only a few days without water.

If people drink water which is not clean, they can become ill and die. About ten million deaths occur throughout the world every year from diseases carried by unclean water. Lack of water and unclean water are responsible for more deaths than all the wars which are happening right now.

Water is needed for growing food. It is needed for livestock. It is necessary even for mining the diamonds that have helped pay for Botswana's development.

In some parts of Botswana, before a marriage can take place, the parents of the bridegroom go to the bride's parents and ask for the *segametsi* – the drawer of water. The name of Botswana's currency, the national motto, and the word for approval – *pula* ! – remind us that water is and always has been regarded as a blessing, a precious gift.

But as the country's population grows, and industrial development increases, more water will be needed.

The water under the ground and in streams may become polluted – from disease organisms or from chemicals spilled on the ground, such as insecticides and industrial wastes.

Some of the diseases carried by unclean water include cholera, typhoid, several types of diarrhoea, bilharzia and hookworm. Mosquitoes need water for part of their life cycle, and mosquitoes can carry diseases such as malaria.

The disposal of solid waste, from latrines and from industries, has to be controlled to prevent the waste from polluting the underground water supply.

Finding, distributing and caring for the water supply needs the work and cooperation of many different people, who need different kinds of training.

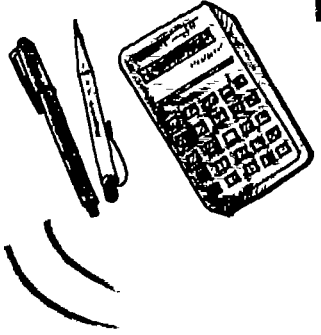
Water Supply

Supplying safe drinking water for a community involves:

- Finding a source of water, and checking its quality, whether there is enough, and whether it will be always available.

- Designing and constructing bore holes, installing pumps etc. for taking the water from the source.

- Designing and constructing storage tanks and treatment plants for purifying the water.
- Providing pipe lines to distribute the water to the community
- Checking the quality of the water
- Proper operation and maintenance of all the facilities.
- Administration and financial management.



Water is a precious resource Though we call some water "waste" water, it cannot be wasted Waste water should be cleaned and used again In waste stabilization ponds, as seen on this page, waste water is treated by useful bacteria, algae, the sun and the wind

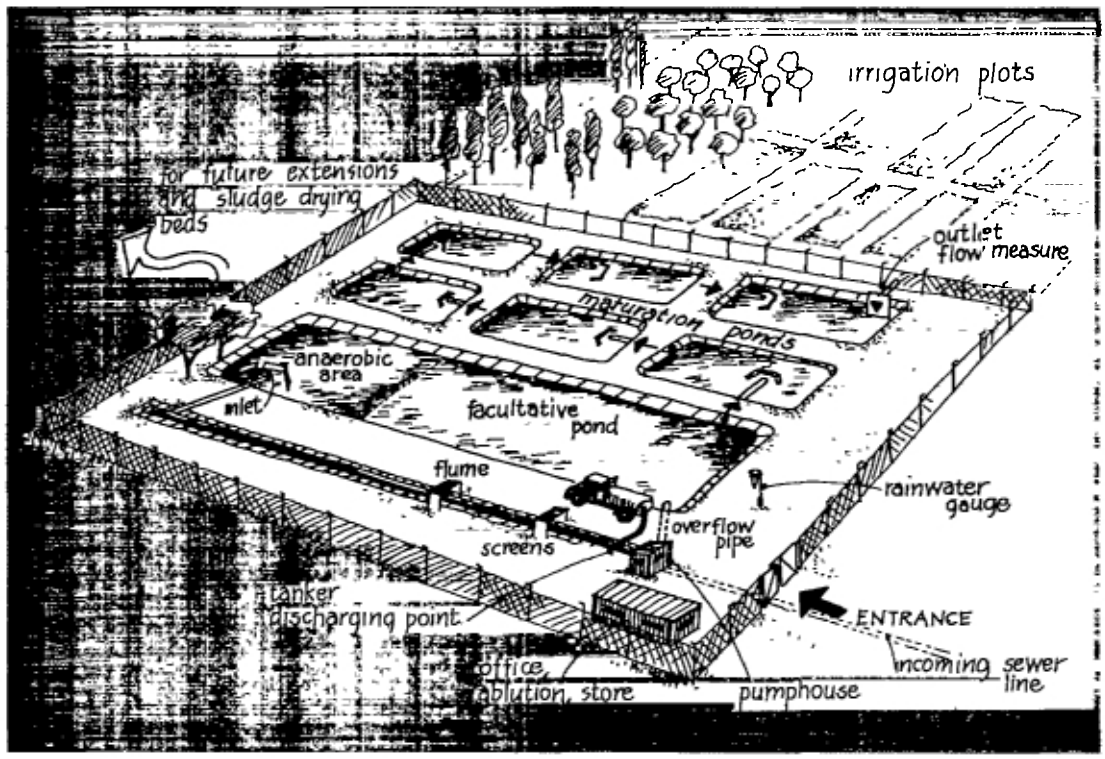
Waste Water

Waste water is water which has been used. That is, the water which goes into the sewer when a toilet is flushed is waste water. The water which was used in Mochudi for helping tan leather was waste water which needed proper disposal. Water which has been used for processing diamonds is waste water.

Proper disposal of waste water involves:

- Finding the places which produce waste water, and checking the characteristics of the waste water and the rate at which it flows.
- Designing and installing sewers to carry the waste water.
- Designing and constructing plants for treating the waste water to make it clean again.
- Re-use and disposal of waste water after it has been treated.

A treatment plant with stabilization ponds

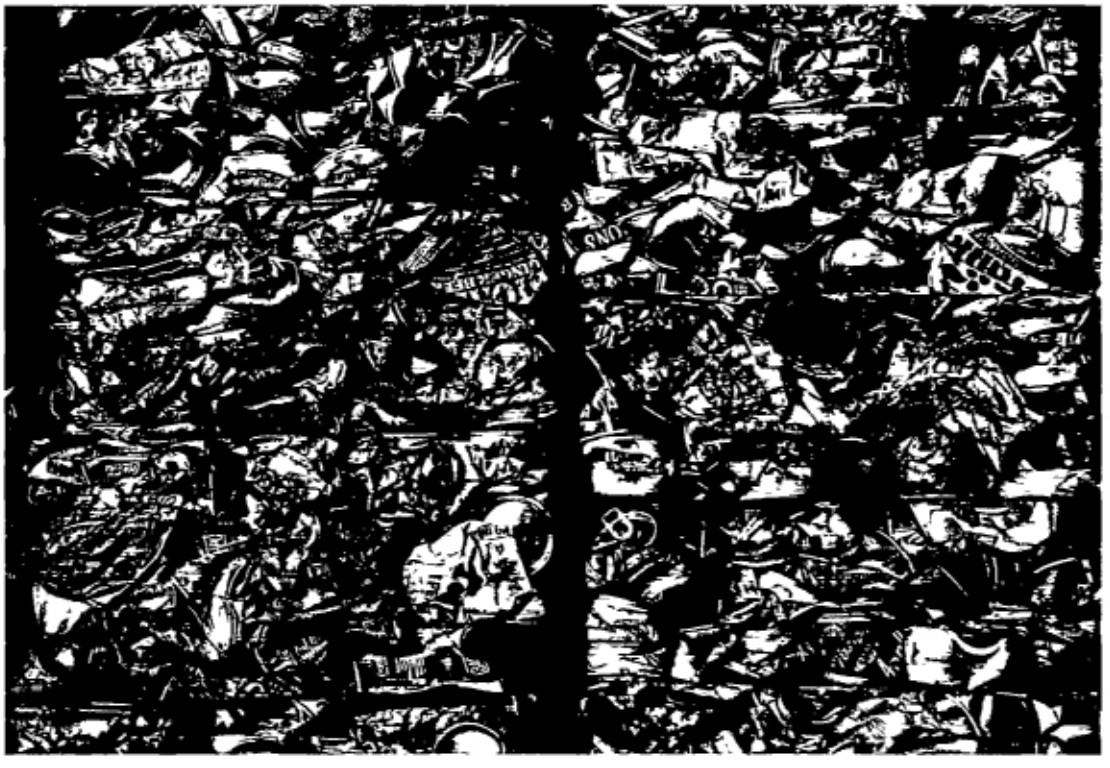


Solid Waste

Solid wastes consist of food wastes, paper, plastics, garden trimmings, wood, glass, tin cans, old tyres, ashes etc. Industries also generate solid wastes, some of which may be hazardous and can pollute the environment.

Solid waste management involves:

- Finding the sources of the solid waste, and finding out what kind of waste it is and how much is there.
- Providing storage bins from which the wastes could be collected for treatment and disposal.
- Determining the type and number of vehicles needed for removing the solid waste, and deciding on the routes they will take for collecting the waste.
- Designing and installing treatment, recycling and disposal facilities.



Solid waste, such as these compressed cans, should be seen as raw material for new products Re-cycling and re-use save natural resources and energy

Great Future Challenges

Young students today who choose the water sector for their careers will meet great challenges for the future. The sector needs a great number of specialists. Providing water for the country's needs is one of the top priorities of the Botswana government. So said Mr. Balisi Bernard Khupe, the Director of the Department of Water Affairs, in the Ministry of Mineral Resources and Water Affairs.

Two ways of storing water A water tower for a part of a town, a bucket for the household

The Department of Water Affairs (DWA) is responsible for managing Botswana's water resources. This means that DWA assesses all the water resources – both ground water and surface water. The department checks the amount and quality of water that is available in different parts of the country.

This information is matched with the needs and demands of all the users. The users include people, livestock, irrigation, mineral production and wildlife. The use of water is determined through the Water Apportionment Board.

Today 70% of the users depend on ground water. The main difficulties in ground water development are:

- the location of the main aquifers are far from the big population centres and it is costly to get the water to the people;
- the recharge of the aquifers is very low and there is a risk that there will not be enough water in the future;
- the ground water is sometimes of poor quality
- the ground water is at great depths and it is difficult to find. When drilling for water, the success rate is low and many bore holes are needed. That costs a lot of money.

Botswana also has difficulties in developing surface water. This is because:

- rivers are mostly ephemeral (i.e. they are not full of water all the time);
- rainfall is low and it evaporates quickly;
- Most of Botswana is flat. That means there are not many good sites for dams;
- most of the natural surface water is in the northern parts of the country, whereas most of the demand is in the south east.

In the future most people in Botswana will have to depend on ground water. But new dams will also have to be built in the north east. A huge pipe line from dams near Francistown will take water down to the Gaborone area. The pipe line will be more than 400 kilometres

long. It is called the North-South Carrier. You will hear a lot about this project in the years to come. Who knows - you will perhaps be part of the project if you choose the water sector for your career.

Water may also be taken from the Limpopo river as part of the projects developed with South Africa. In the next century, water from the Chobe and Zambezi rivers might also be used.

In many parts of Botswana, the only water available is ground water which is salty, so more and better desalination plants will have to be made. In the lands areas, where more than 400,000 Batswana live, less expensive technologies must be used, because it costs too much to put diesel driven pumps and piped water for very small settlements. Improved hand pumps or solar driven pumps, operated and maintained by the people themselves, would be suitable for small rural settlements.

Finally, there may be more use of rain water through *"rainwater catchment,"* or *"rainwater harvesting."* This means that each home can catch the water that runs off the roof or other flat surface, and is drained into a storage place where it can be used when there is no rain. This will save a lot of money and resources.

"In general", said Mr. Khupe, *"we must all be better at taking care of the water resources we have. Water is the country's most important resource, and it cannot be replaced with something else. We cannot hand over a Botswana without water resources, or leave water that is polluted, for future generations."*

Mr. Balisi Bernard Khupe graduated with a Bachelor of Science degree in mathematics and chemistry at the University of Botswana, Lesotho and Swaziland, as it was called in those days. He joined the department in 1974 as a research assistant in the Hydrology Division. In 1976 he started his post-graduate studies in Holland, as an engineering hydrologist. He worked in the Hydrology Division for another eight years and in 1985 went to the University of Newcastle upon Tyne in the UK, where he got his Master of Science degree in Water Resources Systems Engineering. He became the head of the Hydrology Division in the Department of Water Affairs in 1986. In 1988 he was appointed Deputy Director, and in 1993 he became the Director.

Even if you have a good education, it takes a long time and a lot of experience to become Director of Water Affairs. Can <u>you</u> accept the challenge?

Mr. B. Khupe, Director of Department of Water Affairs at the Gaborone Dam

Two Women Working with Water

Ms. Wame Mosielele is a chemist/bacteriologist working for the Water Utilities Corporation in Gaborone. Ms. Ditshupo Kgosilentswe is a supervisor in the Department of Water Affairs, whose area of supervision includes Lobatse, Kanye, Moshupa, Hukuntsi and Tsabong.

Besides the fact that both are women, they have much in common. Both did well in science subjects in school. Both are prepared to work long hours, even on weekends and holidays. They do not mind physical work and do not expect to be dressed smartly all the time.

But there are also some differences. Wame works in an urban area, whilst Ditshupo's supervision is mostly rural. Wame's job deals mostly with analysing and controlling water quality. Ditshupo's work includes planning entire water supply systems for storing and distributing water in her region.

Water from the Gaborone Dam is the main source of water for Botswana's capital The water is treated before it is distributed to the customers. The quality is constantly controlled

Wame

When Wame was explaining how she got into her job, she said *"I enjoyed chemistry and microbiology in school. I was put into the science stream and I did well.... I just had an aptitude."*

She went on to say that she finds her work exciting. *"It is not the normal routine 7:30 - 4:30 job where you go to an office at a predictable time and come home at a predictable time. This has its disadvantages, too, of course. It is all right when you are not attached to anybody but when you are married, you have to have an accommodating partner, who will not mind if you sometimes have to travel or if you come home late."*

She explained that the Water Utilities Corporation supplies Gaborone, Francistown, Lobatse, Jwaneng, Selebi Phikwe and Sowa. *"We supply water to the towns and bulk supplies to others, for example the Department of Water Affairs (DWA)."*

It is Wame's responsibility to make sure that this water is suitable for drinking. The water quality has to be monitored, and if anything goes wrong, she has to find out why, and correct it.

"Our aim is to supply potable water to our customers at an affordable price," she explained. This means that the water has to be good in quality, sufficient in quantity, safe and healthy to drink, and inexpensive. Wame is responsible for making sure that no chemical or biological pollutants get into the drinking water.

Asked about her training, she explained that she has a bachelor's degree in chemistry, but that a degree in biology or environmental science would also do.

Asked what advice she would give to secondary school students about careers in the water sector, she said *"My advice to anyone in secondary school is to make the most of any opportunity to find out what people do in different types of jobs. Work for free, if necessary, just to find out what a job entails. How else will you really find out what a job is like?"*

Ditshupo

When Ditshupo was asked why she decided on a career in the water sector, she explained that there were very few students doing science and she was one of the few selected to do the Pre-Entry Science Course at the University of Botswana.

She was offered the chance to study either mechanical engineering or water engineering, and she thought water engineering would be more interesting. She completed her first diploma course at the Polytechnic in 1980. Asked if the course was difficult, she said, *"The course was okay. It involved a lot of practical and manual work in building construction, plumbing, electrical connections and so on. You need to be prepared to do a lot of physical work and wear overalls, boots and a helmet."*

After finishing the course, Ditshupo was placed in Kanye as an officer in charge of the expansion, operation and maintenance of the water supply system there. Whenever there was a problem, such as a pipe which burst, it was her job to make sure it was repaired.

"This is a 24-hour job," she said. *"There are no definite working hours."* But is that not difficult? *"It is a challenging job, but not difficult,"* she replied.

Does she have any problems being a female in such a position?

"Some men found it difficult to accept a female supervisor," she explained, but she managed to do the work nevertheless.

She was appointed to her present position as Chief Superintendent in 1992. She visits her stations every three months. She checks reports and advises on expansion of existing water systems. Asked if she would encourage women to take careers in the water sector, she said she would highly recommend this career for women. Her advice to students was: *"Students should be prepared to do practical and manual work if they join the water sector. There is no gender discrimination in the water sector; they treat you as an equal."*

Public stand pipes are placed so that the majority of people in villages do not have to travel more than 400 metres to collect water

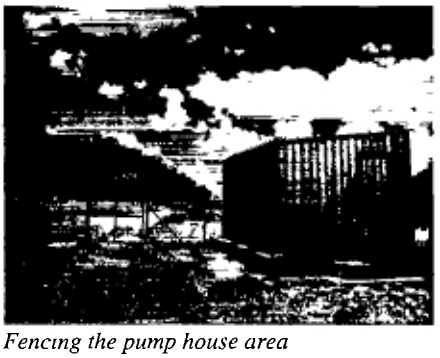
Ditshupo supervises the extension workers

In rural and urban areas, both women and men can find satisfying careers in the water sector.

Botswana Needs Technical Skills

A group of trainees at the Madirelo Training & Testing Centre were discussing their work as borehole mechanics and the training they were receiving.

The type of work you do as a borehole mechanic depends on whether you work with a District Council Water & Wastewater Department, or with the Department of Water Affairs. It also depends upon which district you work in," one of the trainees said.



Fencing the pump house area helps protect the ground water from being polluted

A borehole mechanic needs to know how to equip a borehole - what sort of engine is needed to pump the water, what type of pipes are used for bringing the water out of the ground, and what is needed for distributing the water to the people in the village.

"These boreholes supply water to the people living in a village. If anything goes wrong with the water supply, a lot of people will suffer. So we need a mature person with a sense of responsibility to do this type of work," explained another trainee.

The most common thing borehole mechanics do is to service, maintain and repair diesel engines and pumps which are used for pumping water out of the ground.

Another important task is to check the water level in the borehole. If the water level drops, it might mean that the borehole is running dry. If the borehole is dry, the pump will get air inside and will be damaged if it is left running.

When they were asked how they got started as borehole mechanics, the trainees had different stories to tell.

One man said he started work as a bicycle repair man. *"I was using a bicycle myself. So I learned how to repair bicycles. Then when I grew up, I looked for another job and was employed as a pump operator (Village Water Supply Operator). I worked at that job for some years. Then I applied for training as a mechanic, and was accepted. I took my C certificate at Madirelo, then went for B, and now I am doing my National Craft Certificate. I have been working in the water sector since I finished school."*

A young woman explained that she had a different background. *"I was employed by the North West District Council as an administrative assistant. I have a Cambridge certificate. I worked with the mechanics and saw what they do. I have a theoretical understanding of the job and I am now learning the practical skills."*

Working as a borehole mechanic can be dangerous.

"You can lose a finger - or even an arm - if you are not careful. If some of the equipment is not fastened securely, it can drop down and cut off your finger," said one of the trainees.

However - *"An accident can happen anywhere,"* another trainee countered. *"You can have an accident while driving a car. If you are careless, you can have an accident anywhere. But if you are careful, this job is no more dangerous than most others."*

Bore hole mechanics can spend a lot of time out in the field. When a pump breaks down, and a village has no water, the mechanics have to go to fix it immediately. This might happen on a weekend, on a holiday, or at any other inconvenient time.

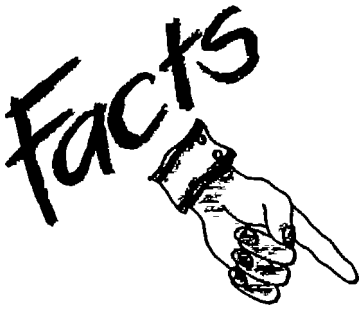
"Sometimes we go to a bore hole 200 kilometres from our workshop," one man explained. *"We may repair the engine, only to find that the water does not come out. So we have to find out why and fix whatever is causing the problem. If we are far away, we can not come back until the job is finished. Sometimes we can be away for as much as 10 days,"* he said.

A young woman explained that the job is no more difficult for a woman than for a man. *"It seems that many students have the aim of becoming doctors or lawyers. But we are not all gifted equally and some students can not make it. They should know that they can progress in a career in some other field, such as a technical one. As African girls we used to have the idea that such jobs are just for men, but now, because there are machines to do the heavy work, I would encourage women to join the water sector."*

This woman also said that getting a promotion depends on your background and education, and added that, *" ..in the line of technical jobs, we are still a developing country and we need technical people. Soon we will have too many administrators. But we will always need water to drink, to bathe in, to flush toilets and so on. And we will need technical people to make sure that the equipment which brings the water to us is working, and that we have enough clean water for our needs."*

Building and equipping a pump house and a bore hole is a job that involves the work of labourers, artisans, water technicians and water engineers. Bore hole mechanics are artisans trained, among other jobs, to install pumps and engines. A qualified bore hole mechanic is familiar with all sorts of jobs at the bore hole (Photo: Peter Healy)

We can not all be doctors or lawyers, and soon Botswana will have enough administrators. The best opportunities - for both women and men - are in technical jobs.



The Water Industry and Its Jobs

If you want to work with water and the environment, you may find a job with the government, with the parastatal organisations or with a private company. There is also the possibility of being self employed.

1 Water Utilities Corporation

The Water Utilities Corporation (WUC) is a parastatal organisation. *Parastatal* means that it is an independently run organisation, but it has certain links with the government. The organisation's main duty is to supply potable water to Francistown, Gaborone, Jwaneng, Lobatse, Selebi-Phikwe and Sowa.

Another important duty for WUC is to provide water in bulk to the Department of Water Affairs and some councils, who in turn supply their customers.

The corporation's slogan is "Save Water – Save Life".

Water Utilities Corporation has its headquarters in Gaborone. It has a number of different departments.

The *Operations Department* is responsible for technical operations. It is divided into four areas: Francistown, Selebi-Phikwe, Gaborone and Lobatse-Jwaneng. Amongst the staff are: engineers, chemists, mechanics, electricians, carpenters, bricklayers, all kinds of technicians, treatment plant attendants and water meter readers.

The *Development Department* is responsible for major development projects. Some examples are: extending the pipe network to new areas of towns; or building new treatment plants for treating the raw water before it is distributed to the consumers.

The *Administration Department* provides a wide range of services: staff recruitment, training and development, personnel administration, legal advice, public relations, secretarial services and others.

The *Finance Department* takes care of accounting and financial control. WUC's turnover was almost 65 million pula for the financial year ending March 1993. The corporation has a data processing section and therefore also needs data entry clerks and computer specialists. The Internal Audit Unit is responsible for auditing activities of the other departments or divisions to ensure that they follow corporation policies and procedures.

There are a total of 750 people employed by WUC. Extensive training is organised through short term courses and on-the-job training. Staff is also sent for training at diploma and professional levels.

2 Department of Water Affairs

The Department of Water Affairs is a part of the Ministry of Mineral Resources and Water Affairs.

The department's main duty is to make sure that Botswana's limited water resources are used wisely. Perhaps the most important of the department's tasks is the responsibility for Botswana's water resources management. That means that the department studies all the country's water resources, both ground water and surface water. It finds the amount of water that is available in different parts of the country and checks the quality of the water. This information is then matched with the needs and demands of all the users. The users are not only individual people. Water is needed for livestock, for irrigation of wood lots and food production, for mineral production, and for wildlife.

The department has many specialised divisions and sections. There are five major technical divisions.

The *Groundwater Division* finds places to drill and test-pump bore holes. This division also checks the groundwater flows and level of underground water and its quality.

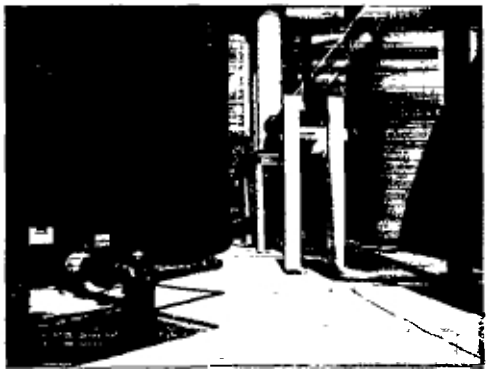
The water engineers and technicians of the *Design and Construction Division* design and build water supply systems and waste water schemes for villages all over the country, including those that belong to the local authorities.

The *Operation & Maintenance Division* is responsible for operating and maintaining the water services to the 17 major villages in the country.

The *Hydrology and Water Resources Division* studies the flow and behaviour of water in the landscape, be it underground or on the surface. They also study how water resources can be used without harmful effects to the environment. The division also carries out long term planning for water resources management.

The *Electro Mechanical Division* installs and repairs engines and pumps for the bore holes. The division is also responsible for installing solar powered pumps.

Besides the technical divisions there are supporting sections like the *Training and Staff Development Section*, the *Water & Wastewater Analysis Laboratory*, the *Administration Section* and the *Law Section*. The officers of the Laboratory are responsible for taking water and waste water samples which they analyze for checking the quality and pollution. The Law section people are there to make sure that the Water Act and other related acts and regulations are followed. They also allocate water resources through the Water Apportionment Board.



Part of a water treatment plant.

At present there are more than 400 permanent and pensionable staff posts and more than 2 000 workers within the department. The permanent and pensionable posts are divided into the following groups:

- professional staff such as engineers, hydrogeologists, hydrologists, computer specialists, chemists, botanists;

Correct technical drawings are essential for estimating costs and for efficient construction work in the field.

- technical staff such as technical assistants and technical officers specialising in various fields such as water engineering, electrical and mechanical engineering. The technical staff is divided into two main groups, those with a technician's training and those with an artisan's training;
- general administration staff, such as administration assistants, administration officers and secretarial staff.

There are staff shortages especially amongst the professional and artisan cadres. Department of Water Affairs has an in-service training programme for Form five leavers. This programme is similar to that of Department of Geological Surveys, (see below).

DGS compiles a lot of information about the geology of Botswana

3 Department of Geological Surveys

The Department of Geological Surveys (DGS) is responsible for the assessment of minerals and underground water. The department collects and stores geological information, and presents the results of surveys in the form of maps and reports. It is one of the departments under the Ministry of Mineral Resources and Water Affairs. Its responsibilities include the following:

- geological mapping, which means making a map of the different classifications of rocks, including their mineral content;
- assessment of ground water resources;
- collecting, analysing and storing of geological, hydrogeological and geophysical information;
- providing information about Botswana's geology to the public.

The Department of Geological Surveys has five main divisions and four support divisions. The main divisions are; administration, hydrogeology, economic geology, regional geology and finally geophysics.

The support divisions are; drilling, chemistry/laboratory, mineral dressing, and cartography.

The department gives priority to environmental protection. The department is aware of the dangers of uncontrolled urbanisation. In particular, the protection and wise use of ground water is studied carefully.

There will be many job opportunities for technical people in the future.

Form Five leavers with credits in mathematics and science subjects such as physics and chemistry are recruited by DGS as Technical Assistant trainees. After two years of on-the-job training they sit for the Public Service Commission Examinations. Those who pass are employed as Technical Assistants. After one to two years, these are sent (at present) for further training. This training normally takes two to three years, and the successful trainee gets a diploma. They then become Technical Officers. They can then progress to Senior, Principal and Chief Technical Officers. A Technical Officer may also go for a degree course, after which he/she qualifies as a professional.

Professionals join the department with a bachelor's degree from a university. They can join as Assistant Hydrogeologist or Geologist, and progress, with training, up to the level of Principal Hydrogeologist.

Artisans, also, can progress; they may be trained and promoted to Senior Technical Assistant, Principal Technical Assistant and Chief Technical Assistant.

Although at present there are very few women in the technical fields in the Department of Geological Surveys, one of their representatives says that the reason is because few women have applied.

4 Local Authorities

The local authorities that deal with water, waste water and solid waste are divided into three types of councils: the district councils, the town councils and city councils.

District Councils

There are nine district councils. In each council there is a Water & Wastewater Department. These departments are responsible for supplying water to more than 400 rural villages. In most districts the department is also responsible for the waste water schemes.

There are roughly 1,600 posts within the departments. Half of them are water supply operator jobs posted in the villages. For most of the 300 permanent and pensionable posts an artisan's or technician's background is suitable. A growing number of technicians and professionals with a background in water & waste water engineering are needed.

Each department has its own organisation based on the needs of the district. But in almost all you will find five different sections: operation & maintenance, construction and repair, design, waste water, and finally an administration section. All departments should in the future be headed by a professional in water & waste water engineering.

Town Councils and City Councils

The town and city councils are responsible for the waste water services. These services are in most cases taken care of by the sewerage section that falls under the engineering department.

Public Health Department

In most councils (district, town and city councils) the solid waste is taken care of by the Public Health Department. The department has many responsibilities but among them is the collection of human and industrial waste. It must make sure the waste is disposed of in an environmentally safe manner. In the department there are jobs such as Public Health Inspector, Environmental Health Inspector or Public Health Engineer. There are all levels of jobs: artisans, technicians and professionals.

Ministry Support to Local Authorities

The Technical Unit is a unit of the Ministry of Local Government, Lands & Housing. The unit has the overall responsibility to ensure that the council's water & waste water departments can and do provide water and waste water services. The unit does that by making sure that funds are available for development projects and then coordinating these projects. The total cost to provide water services in all district councils amount to nearly 60 million pula a year (1993). The Technical Unit is also responsible for coordinating the waste water services in the councils.

Another department of great importance at the ministry, is the Department of Local Government Service Management, DLGSM. This department is responsible for the employment and training of top level artisans, and all technicians and professionals needed in the local authorities. The training division in DLGSM organises training programmes

for water sector staff and co-operates with training institutions in Botswana and outside the country.

5 Private Sector

The companies in the private sector which work with water can be divided into three groups: (1) consultants, who do mostly designing and supervising; (2) contractors, who do the work which has been designed by the consultants; and (3) suppliers, who supply the goods needed by the contractors.

The design and construction of septic tanks is part of the water and waste water engineering sector

The consultants and contractors have many types of activity, including exploration for water and supply of the equipment needed; waste water engineering, and environmental engineering. There are consultancy firms that specialize in a particular type of activity. However, most of the firms have a broad approach and when they need specialized help they hire people who have the right kind of knowledge. Consultants often make feasibility studies - i.e. preliminary studies to find out what will be needed later. For this they employ other consultants, such as those who specialize in development, administration or economics.

Contractors, however, usually specialize in only one aspect of the water sector. This is because they have to buy very expensive equipment which is used for only one type of work.

There are around 20 consultancy firms which deal with the water sector based in Botswana. Most of them have their offices in cities and towns.

Contractors number about 50, and they operate from many locations, including villages.

There are perhaps 1000 people who are working as permanent staff for private firms within the water sector. This does not include unskilled labour employed on a piece job basis. Many companies hire unskilled labour from nearby communities for short term work.

Good Qualifications Needed

Most consultants need at least a Bachelor of Science (BSc) or Master of Science (MSc) degree in geology, geophysics, hydrogeology, hydrology, civil engineering, environmental engineering or mechanical engineering. However, if you have a great deal of practical experience it is possible to work as a consultant with Higher Technicians Diploma.

After the consultants finalize their designs, the contractors come in to do the actual work. Contractors employ professionals, technicians, artisans and skilled labourers.

Private companies believe that education is very important, and they encourage their employees to get as much education as possible. Some ways to get further education are:

- In-house training, in which an employee works with a more experienced professional. This method is often used for employees who have recently graduated and who have no work experience. The experienced person guides and monitors the one who is getting training. Sometimes in-house training is linked to a university or other official training institution, so that at the end of the training, the trainee can get an officially recognized qualification.
- Short courses given by official training institutes.
- Further study, after a few years of gaining work experience. Sometimes the consultancy firm sponsors further training, either in Botswana or abroad.

The water meter reader checks the amount of water the customer has used

The information is compiled at the office and a water bill is sent to the customer

The customer pays the bill If the bill is not paid, the water supply is disconnected.

The Internal Audit Section checks regularly that all figures are correct

Administration Jobs are Important

There are many administration jobs within the water sector. Some administrative tasks are performed by the technical staff. But there are also specialists in administration such as personnel and training officers, computer specialists, financial managers and accountants, secretarial staff etc. Technical staff and administrative staff must work well together to deliver water and waste water services.

On page 16 it is mentioned that WUC earned almost 65 million pula. That income comes from the selling of water. There are many administrative jobs behind creating that income.

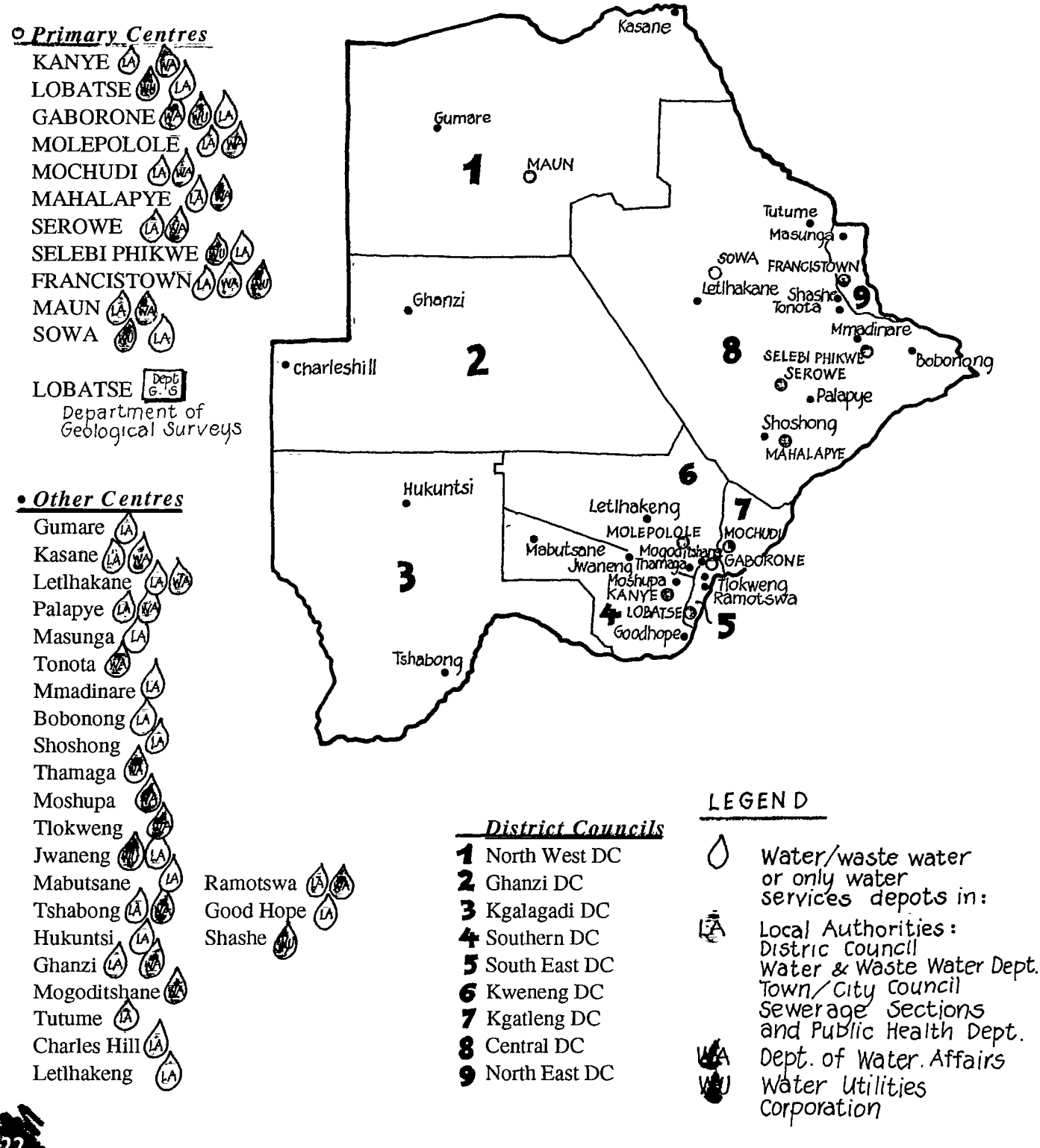
Work Attitudes

A person's attitude towards work, and personal qualities are important in any job. A private company's or government department's reputation is based on the way the employees work, how well they co-operate and how they communicate with their clients.

All employers say they want mature people who can work without being told exactly what to do. They want employees who have a sense of responsibility, initiative, enthusiasm and self reliance. Their employees should use common sense, have an inquiring mind, be friendly and communicative, and always willing to learn. If a job needs to be done, it must be done on time, even if the employee has to change some of his or her personal plans. When you have a job, you should not expect your employer to treat you like a child; you must behave like an adult, and treat your job as if it is your precious child.

Where to Find Jobs

Jobs in the water sector can be found almost all over the country. Here is a map showing most of the places where there are depots for water and waste water services. These are organised by either Water Utilities Corporation, or Department of Water Affairs or Local Authorities. Department of Geological Surveys headquarters is in Lobatse.



How Many Women...?

How many women are working in the water sector, as compared to the number of men? Some of the organisations who employ people in such jobs sent us the figures. As you will see, there are very many more men - especially in senior positions - than there are women.

Why is this? There might be several reasons. Perhaps girls do not believe science careers are suitable for them. Maybe they were influenced to think that way by their parents or at school. What we do know is that more women are needed in these types of jobs, and that women are just as able to do the work as are the men.

Number of employees (April 1994)	Water Utilities Corporation		Department of Water Affairs		Department of Geological Surveys		Local Authorities	
	Women	Men	Women	Men	Women	Men	Women	Men
General administration	98	266	147	39	1	1	18	32
Workers	1	237	3	1960	2	26	198	1330
Artisans	–	65	1	83	2	8	4	57
Technicians	18	53	2	90	–	5	2	55
Professionals	8	27	5	40	1	15	–	8

1) *General administration* includes messengers, cleaners, administrative assistants, typists and other secretarial staff, financial staff, supply staff and all other administrative staff who do not have a bachelor's degree or above.
2) *Workers* are all technical staff below technical assistant level. This category includes both unskilled and skilled staff It also includes drivers.
3) *Artisans* includes technical assistants, senior technical assistants and technical officers with an old Trade Test A certificate or a new National Craft certificate.
4) *Technicians* includes technical officers and above with a technician's diploma
5) *Professionals* includes all officers with at least a bachelor's degree.
6) The figures for *Department of Geological Survey* include only those directly involved in the water sector

Get Yourself a Strong Base!

Geoflux is a young company based in Gaborone and owned by two Batswana men: Monty Chiepe and Chilisana Marobela.

"*Get yourself a strong base,*" said Monty Chiepe, one of two managing directors of the company called Geoflux. This was his advice to any student who wants to have a good future. The stronger the base you have, the wider the range of careers to choose from. Monty said that he has realized that all subjects in school eventually turn out to be relevant later in life.

Monty and his partner, Chilisana Marobela, started Geoflux in 1989, when they were both about thirty years of age.

Monty

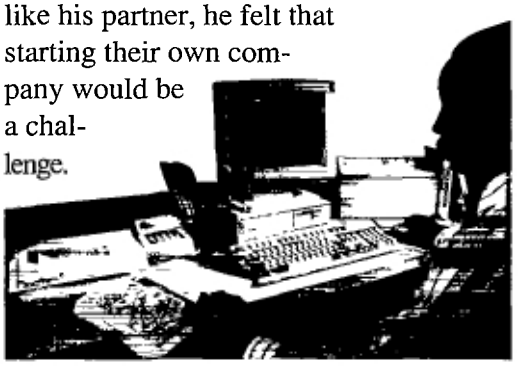
Monty is a geologist who studied Geological Engineering Technology and Geology in Canada. To get as much experience as possible, he worked between university semesters for private companies which were looking for minerals. In one case, he even worked for free, because he felt he was gaining experience which would later make up for the lack of payment.

After he completed his studies, he worked with the Department of Geological Surveys in Lobatse, and later with two private companies before deciding to set up his own company with his partner.

Chilisana

Chilisana, who is commonly called "Chili," decided early in life that he wanted a job where he could spend a lot of time in the field. In 1977, his secondary school teacher took the class to the Orapa mines. On that study visit, Chili made up his mind: *"I want to study geology!"*

Chili also studied at the University of Botswana, where he got a degree in geology. Later he went to the University of London, where he got a master's degree in hydrogeology. Like Monty, he worked for a while at the Department of Geological Surveys in Lobatse. But, like his partner, he felt that starting their own company would be a challenge.



What Does Geoflux Do?

Geoflux company offers consultancy services to government and the private sector. It uses modern instruments and advanced computer programs. The

company specializes in groundwater, minerals and surveying.

Geoflux has specialists in the fields of geology, surveying, hydrogeology and geophysics. The company also employs technicians and administrative office staff. Labourers are employed from time to time, on a temporary basis.

A geologist is a scientist who studies the earth and all its characteristics, including how it was formed. A hydrogeologist is a geologist who specializes in finding and assessing groundwater, i.e. water which lies under ground.

Geologists and hydrogeologists need to know a great deal about many things. They need to understand how rocks are formed and how they store water. Sometimes it is easy to find water, but there is not enough quantity. Or sometimes the water is not good – it may be too salty to drink, or in some cases it might be polluted.

Monty and Chili start by checking old records which may give information about a part of the country where they are trying to find water. Then they study satellite images and aerial photographs - photographs taken from an aeroplane or from a satellite in space. With the help of special equipment, they can tell, for instance, how easily electricity can pass through the different types of rocks under ground. They can also analyze the magnetic fields within the rocks. There are other methods, too, which help them know whether there might be water under the ground.

Once the water has been found, Geoflux has to take samples to find out if the water quality is suitable. Test pumping has to be done, to find out how much water can be pumped over a period of time.

Sharing Experience

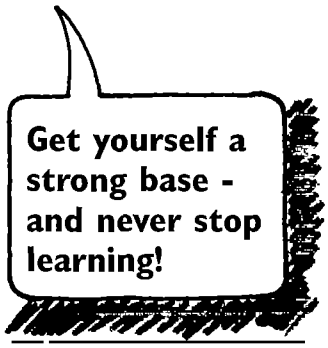
Monty and Chili explained that when you have a technical, scientific career, you should join a professional association to keep up to date with the latest techniques and information. They belong to the following:

- Botswana Geoscientists Association
- Association of Groundwater Scientists and Engineers (U.S.A.)
- National Water Well Association (U.S.A.)
- International Association of Hydrogeologists
- International Association for Environmental Hydrology

What Kind of Person Works for Geoflux?

When they want to employ someone, what do Monty and Chilisana look for?

Monty answered: *"First of all we look for what the company needs in terms of knowledge and skills. We also want to be sure that a person can match our team and the spirit we have within the company. We must have staff members who can work independently, who can supervise themselves. It is also important that the person is motivated and prepared to learn. You never finish learning. There is no such thing as 'fully learned'. You must constantly learn new things, constantly improve your performance. You learn from your colleagues, and that is why it is so important to have a team spirit. Finally, you must be well disciplined and prepared to work hard and long hours. Eight hours a day are never enough!"*



People Need a Good Water Supply

Water and waste water systems in rural areas are taken care of by the District Councils' Water and Waste Water Departments. Unlike most urban water supply services, the rural ones are subsidised - that is, the government helps pay the costs of supplying water, because it is too expensive for individual users to pay for everything.

The head of the Water and Waste Water Department for the Southern District is Mr. N.C.M. Mchaile, from Tanzania. He has a Master of Science degree, a post-graduate diploma, and he had many years of experience before he came to Botswana.

While explaining the duties of his department, he said *"Our task is to provide a good water supply to the people."*

But that is sometimes not easy. Mr. Mchaile and his assistants are responsible for a large area which includes three sub-districts. These are Goodhope, Kanye/Moshupa and Mabutsane.

The Water and Waste Water Department is divided into two main sections, Mr. Mchaile explained. *" These are: (1) Operations and Maintenance, and (2) Construction and Repair. The Operations and Maintenance section - O&M as it is called - is responsible for the daily operation of all water supply systems in the villages. This section organises the village Water Supply Operators and their supervisors, the Technical Assistants. The Construction and Repair, or C&R, section includes specialised crews of borehole mechanics and pipe fitters. They also have workshops where for instance diesel engines and other equipment can be repaired,"* he said.

The department also has an administration section, with a supplies office and a transport planner. They help to make sure that the department runs efficiently.

"Administration is very important. Our administration officer is assisting me, keeping track of personnel issues and so on," Mr. Mchaile said.

A good administrator can work in almost any office, but technically trained workers are needed for the jobs that only they can do well. There must be enough technically qualified people to help the department do its task of providing a good water supply.

What qualifications are required for the post of head of department of a big district council water & waste water department? *"At least a master's degree,"* Mr. Mchaile stated. *"The person should have not less than five years' experience at a senior level. Perseverance and skills in public relations are also important. And membership in a professional organisation is needed, to keep a person in touch with the latest developments in the technical field."*

Someone once said that the most important thing a leader needs is the ability to take responsibility. When he was asked about problems related to the job, Mr. Mchaile said *"I am almost permanently on stand-by, as breakdowns will be reported any time and I have to mobilize a crew and tools to attend to it irrespective of 'normal' working hours."*

The general public, the councillors, politicians and others sometimes do not understand the technical duties of our departments. *"We have to be patient when we attend kgotla meetings,"* Mr. Mchaile said.

The main duties of the head of the Water and Waste Water Department for the Southern District are:

- providing water supply services of good quality;
- providing professional and administrative leadership to the department;
- ensuring implementation of government policies, council resolutions etc.;
- ensuring a line between the people and the Council in matters related to water and waste water services;
- monitoring activities of the department;
- preparation of budget estimates, control of expenditure;
- planning of department affairs and co-ordination with other government departments, such as the Department of Water Affairs.

If you are willing to learn from others, and if you do not give up easily, you will not fail.

Mr. Mchaile's advice to anyone who hopes some day to reach a senior position is as follows: *"What I can say for sure is that you will never be able to take over unless you are prepared to learn from an experienced person. If you think you know it all and are not prepared to learn from experienced people, you will never succeed."*

Botswana needs experienced, qualified, skilled and motivated women and men.

District councils are responsible for the water supply services in more than 400 rural villages Water from public stand pipes is only for domestic use. It should not be used for livestock watering. Consumers do not pay for water from public stand pipes

Head of department, Mr Mchaile, with one of the department's pipe fitters, Mr Jona Tshelwane

A Pipe Fitter Named Jona

Mr. Jona Tshelwane, who comes from Mmadinare, is a pipe fitter on his way up. Jona works with Mr. Mchaile at the District Water and Waste Water Department in Kanye, but he is taking further training for his National Crafts Certificate (NCC) and he is hoping for a supervisory post when he completes his training.

"I completed Standard Seven, and then got a certificate in brick laying. But I did not like brick laying," Jona explained. *"So in 1975 I got training as a pipe fitter. I started work in June, 1977, with the District Council. Now I am doing NCC. It takes four years. You need a lot of maths for NCC,"* he said.

Why do you need so much maths? He answered: *"To know how much water is needed in a village, you need to know the population, what kind of pipes, what diameter pipes are needed, the flow of the water.... and a lot more. We can use a calculator, but we still have to know which figures to use."*

He explained that his job includes installing the pipes which take the water from the pump at the bore hole, to carry the water to the storage tank and the stand pipes. *"I lay the pipes, put in the different valves, construct stand pipes and put up the water tank. It is very difficult. But I like it."*

Some of the difficulties he faces include erecting the water storage tank. *"It is dangerous,"* he explained. *"The tank can be higher than six metres You can fall off. And you have to spend a lot of time out in the bush, doing heavy work, cutting trees, surveying ."*

He finds surveying especially difficult. Why? *"Maths, maths, maths!"* he answered, laughing.

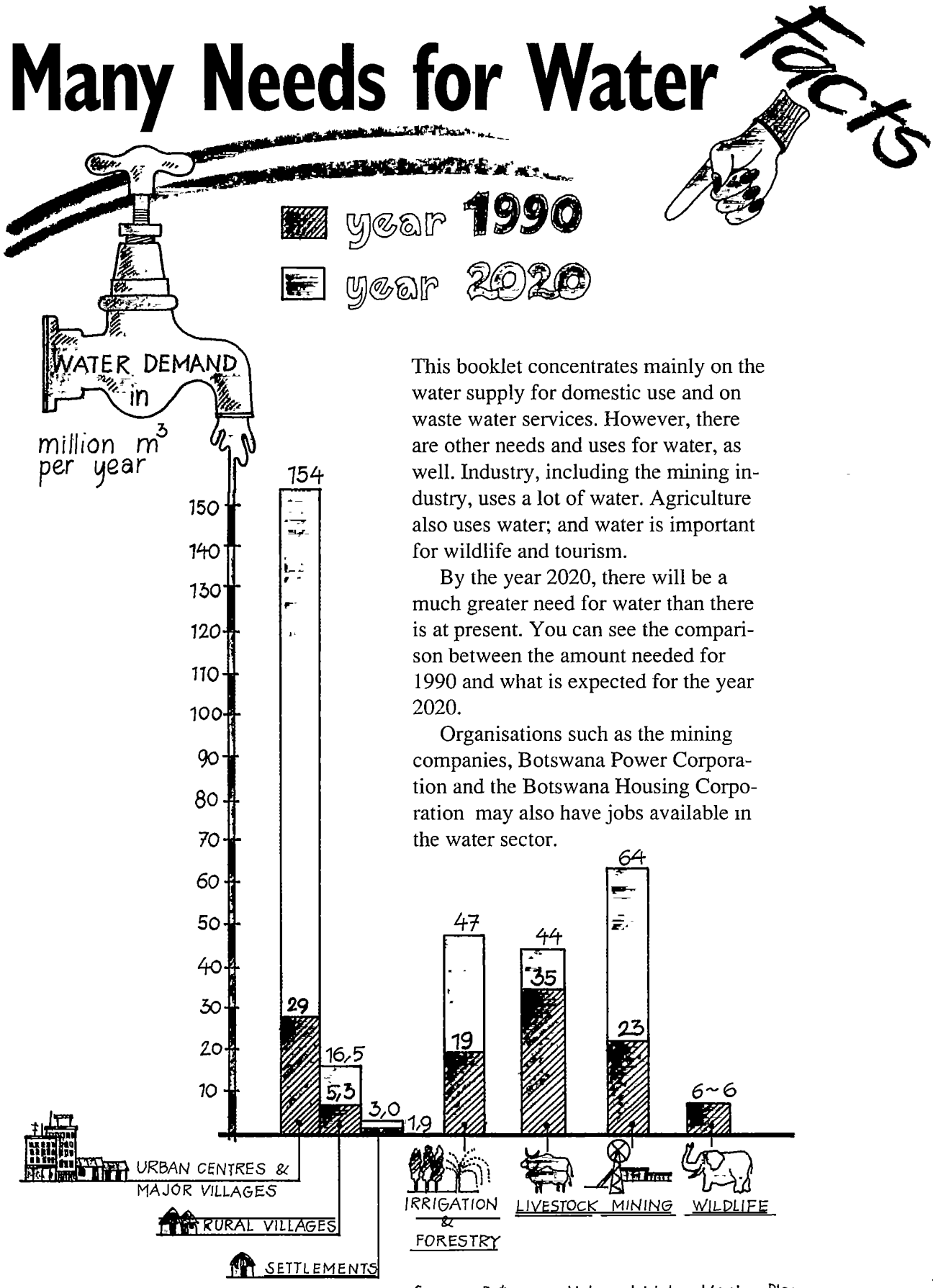
Asked for his advice to students who may be thinking of doing pipe fitting, he said *"We spend more time in the bush so if you like to stay in an office you should not do this job."*

"What I like is that the job is fast," he continued. *"You complete the work quickly and go on to another job. I like to complete the job and see that I have done something.*

The more you work the more you know the job well," he added. *"And you should work with someone who you think can perform the work well, if you want to learn more,"* he said.

With that attitude, he will surely succeed.

Many Needs for Water



This booklet concentrates mainly on the water supply for domestic use and on waste water services. However, there are other needs and uses for water, as well. Industry, including the mining industry, uses a lot of water. Agriculture also uses water; and water is important for wildlife and tourism.

By the year 2020, there will be a much greater need for water than there is at present. You can see the comparison between the amount needed for 1990 and what is expected for the year 2020.

Organisations such as the mining companies, Botswana Power Corporation and the Botswana Housing Corporation may also have jobs available in the water sector.

Source: Botswana National Water Master Plan, DWA

From Water Supply Operator to Bore Hole Mechanic

Ms. Dorcas Morolong is a young mother of three who started working as a Water Supply Operator (WSO) in her home village of Mosi (Southern District) in 1989. In the following year she was sent to Ramatea for training.

"They taught us how to keep the log book, how to clean the pump house, how to keep the tools and how to service the engine," she explained. She also learned to repair a leaking water pipe and how to take care of a stand pipe.

Dorcas' job as WSO was a very responsible one. She had to make sure that her village had a regular supply of clean water. If the engine or the pump which pumped the water from the ground was not working, or if there was a leaking pipe or a problem with the water storage tank, it was her duty to fix whatever was wrong. If she could not fix it herself, she had to report the problem to the headquarters in Good Hope. If the problem was with the engine, a bore hole mechanic would come to repair it.

So Dorcas decided it would be better if she, herself, could learn how to repair and maintain engines. Because she was conscientious and good at her work as WSO, she was chosen for a course at Madirelo Training and Testing Centre in Gaborone.

"It was a six-weeks' course," she explained. *"The course included dismantling the engine, how to set the tappets, how different types of engines work..."* After completing the course, she was transferred to Good Hope, where she started working as a bore hole mechanic.

Asked if the work was difficult, she said no, not when you get used to it. *"Some people refuse because always you get dirty - you get oily every time if you are dismantling an engine. Pulling a rising main is a heavy job. But I don't mind,"* she said.

Asked if the work is heavy for a

woman, she said it was not. *"Some girls do not like to do heavy things - they ask the labourers to do it, they do not do it with their own hands. Me, I do the work with the men,"* Dorcas said.

The bore hole mechanics course was in August, 1992. In October, she went for a pipe fitters' course, also at Madirelo.

"We learned how to connect private connections, to put a water meter for a stand pipe, to connect PEH hose to GS pipe," she said. Asked what that means, she explained that PEH stands for "polyethylene high density," a kind of flexible plastic pipe. GS means "galvanized steel" - the sort of metal used for stand pipes. The two types of pipes can not be joined without a special adapter.

At present Dorcas has an office at the District Council Water Department in Good Hope. Because she has a baby only four months old, she is allowed to go home at 11:30 and return to work at 2:00, in order to breast feed the baby. When the baby is six months old, she can stop breast feeding and then she will be able to travel to visit other villages in the district when an engine needs repair or when she is needed as a pipe fitter. When she is not at home, Dorcas' younger sister takes care of the baby.

Dorcas' supervisor, who is the Senior Technical Officer in the department, explained that the courses offered at Madirelo are in two streams, pipe fitters and mechanics. Each stream has a "C" level course which is purely practical and can be taken even by someone who does not know how to read - a C(P); and a "C" course which includes both the practical work and the theory - for which the student has to be able to read. This is called C(P&T).

After the "C" level comes the "B" certificate, for which you have to know how to read, write and speak English.

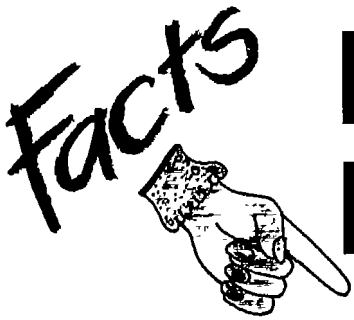
"There are great possibilities for advancement if you can pass the courses, and do the job well," he explained. *"Dorcas could go as far as Senior Technical Assistant, if she qualifies,"* he added. *"This job is open for Junior Certificate leavers, if they take the courses at Madirelo, up to the National Craft Certificate (NCC)."*

When speaking with Dorcas, you may notice that she has a very good understanding of the technical details of her work. But most of all you will see that she is enthusiastic about her job. She loves it. And she is a person who likes to be actively doing things, not just sitting behind a desk.

With those qualifications, there is no doubt that she will progress very far.

Both women and men need to understand the technical details of their work, to be enthusiastic and to be active in order to succeed.

All district council water & waste water departments regularly organise training for their water supply operators Such training includes how to service and maintain a diesel engine



Protect the Environment!

What does "environmental protection" have to do with careers in the water sector? And what does solid waste management have to do with water?

Spreading and compacting solid wastes at a landfill site

"The environment" means everything that surrounds us, including the land, the air and the water. And solid wastes – that is, any solid material that we throw away, such as garbage, metal cans, bottles, plastics, paper, garden waste and so on - can pollute both air and water, not to mention the fact that they give homes to rats, mosquitoes and cockroaches. And even our cattle can be badly affected when eating plastic bags or when stepping on broken glass or sharp pieces of metal.

An engineer is a person who knows how to design things and make them work. There are many kinds of engineers, and one of these is the environmental engineer. The job of an environmental engineer is to help preserve and protect the environment, and that includes keeping it clean and free from pollution.

Environmental engineering subjects can be classified into the following sections:

- water resource management (including waste water)
- wastes management (including both solid and liquid waste)
- air resource management

But there is no strict boundary between these topics. For example, burning of rubber and plastic (solid waste) releases poisonous gases into the air, thereby polluting the air. If these gases mix with water vapour and fall down as rain, they can pollute the rivers and seep into the ground water system.

Managing solid waste so that it does not harbour rats, cockroaches, mosquitoes and other pests is also a concern of environmental engineers. This means that the engineer has to design a good system to collect and transport the waste. Some of the waste can be recycled – made into something useful. An environmental engineer has to understand city and regional planning, conservation, economics and administration.

In the past, the lifestyle in Botswana was different from what it is today. There were not as many people as there are now. There were more resources. People could move to a new place when the old one got dirty and the resources were becoming scarce.

Today, the population of Botswana is increasing at a very fast rate. It will probably reach two million by the year 2000. These people will need more resources, and they will create more rubbish.

Changing lifestyles also create more rubbish. Computers, TV sets, cars and videos did not exist in the past. There

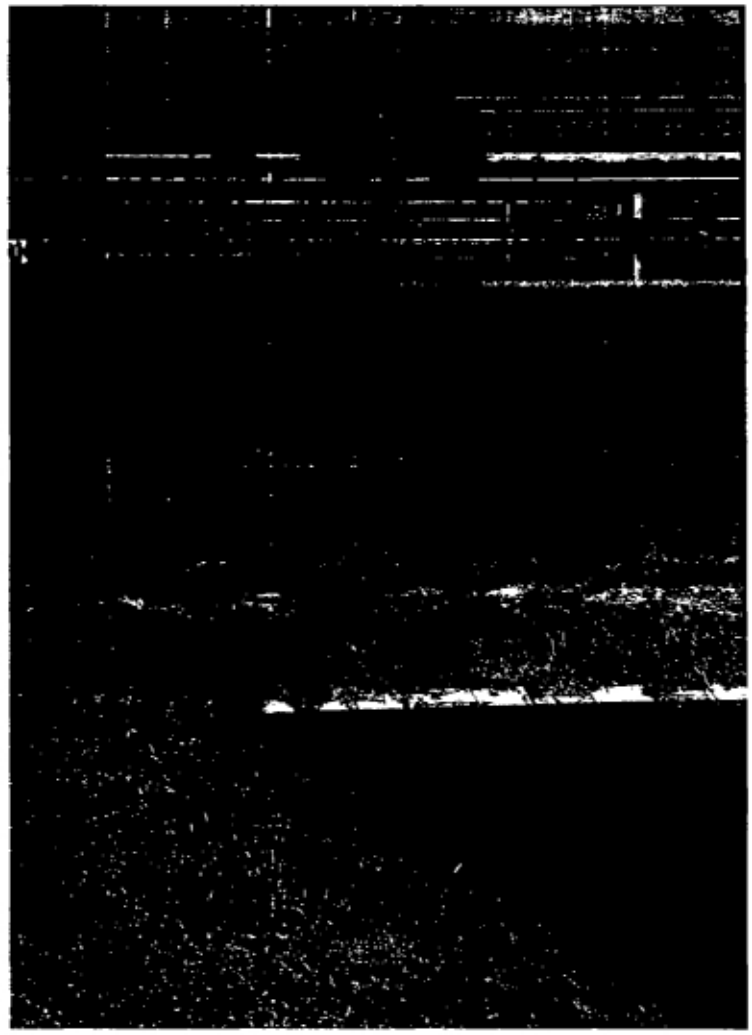
are very many of them in use today, and these will be the rubbish of tomorrow.

Some guidelines are given by the National Conservation Strategy. The National Conservation Strategy is a plan adopted by the Botswana government for conserving the resources and protecting the environment. It covers eight main areas: fisheries, arable crop farming, veld products, livestock, forestry, uses of wildlife, tourism and urban development. The National Conservation strategy emphasises sustainable development - development which does not destroy the resources, but replaces them and conserves them.

For example, waste water, if cleaned and treated, can be recycled for use in all the eight areas mentioned in the National Conservation Strategy. If waste water is re-used, or recycled, we will not need to pump so much water out of the ground, and thus we can have sustainable development of our water supply.

So an environmental engineer faces a challenge: That of providing the people with what they need, without destroying or polluting the environment.

The waste stabilization ponds are shallow, artificial "lakes" for waste water treatment The ponds also provide an environment for many rare species of birds

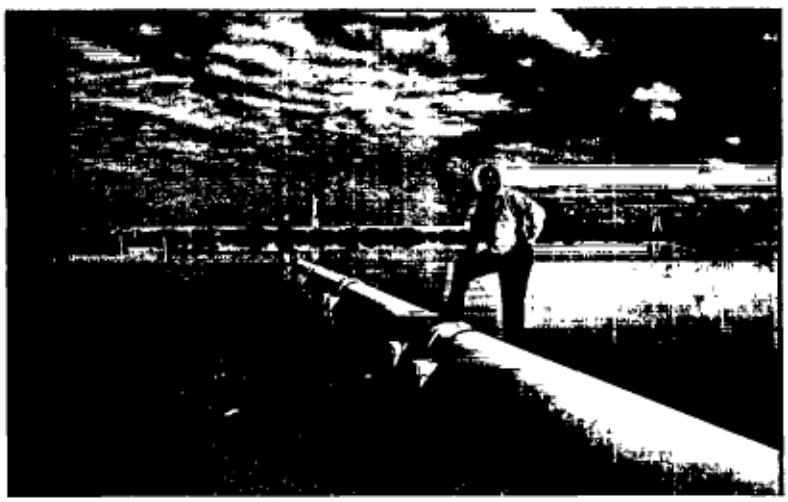


Using water to transport waste is expensive Large amounts of clean water are used to flush away a small amount of waste. Waste stabilization ponds also require much land, and land is expensive However, using pit latrines or other types of latrines in urban areas creates other problems There is no "best" technical solution for all situations. The environmental engineer must find a solution that can balance a number of factors environmental (which includes sustainable use of natural resources), human, financial and technical.

Environmental engineers are needed to plan for sustainable development - so that our children will be able to enjoy at least as many resources as we have now.

It's Not Sewage - It's Waste Water

Mr. John S.N. Khupe, Senior Sewerage Engineer for Gaborone City Council, was asked to talk about his work with waste water management in Gaborone. Here is what he said:



Q. What is "waste water"?

A. *Waste water is the updated phrase for what used to be called sewage. It includes the waste from flushing toilets, kitchens, bathrooms, laundries, industrial operations, commercial enterprises, things like hospitals and schools – in other words, the liquid waste.*

Q. What type of work do you do in your job?

A. *I am responsible for the sewerage systems in the city, including treatment and disposal. That means everything - planning, implementation and everything between.*

Q. Why is it important to treat waste water?

A. *To protect the environment. The environment holds so many things – it includes human beings, plants such as trees, birds, animals – even insects...*

Q. For generations we have been using water and depositing waste. Why is it only now that we need to treat it?

A. *Because now technologies have proved to us that indiscriminate disposal of waste degrades and pollutes the environment and affects the ecosystems and the ecology in general.*

(This is a technical way of saying that we now know that too much waste material is not good for us and our environment.)

Q. How do you plan for waste water disposal in a city like Gaborone?

A. *You have to identify the kind and amount of waste water that will have to be disposed of. Then you plan and design the collection pipe work – i e the sewers – which transport the waste water to the treatment plant. You also have to design a treatment plant suitable for the flows and the quality of waste water, i.e. the hydraulic loading, which means the flow and quantity of water. Then you have to look at the organic loading, i.e. the food for micro-organisms It is the*

micro-organisms that decompose the organic matter in the waste.

You can choose a scheme. There are many systems for waste water treatment. Commonly in Botswana we use oxidation ponds, also called stabilization ponds. They oxidise and stabilise the organic matter.

The Gaborone City Council is switching over to a new system called "activated sludge." The Gaborone City Council activated sludge system is awaiting construction. The planning designs have been completed, the budget is there.

Q Why is Gaborone City Council switching to this system?

A. *Because there is a very large flow due to Gaborone's growth. This makes it difficult for oxidation ponds to cope with the volume of flow. Also we would like to produce effluent of a better quality than we are doing now, so that more of the water can be re-used. We have to economise on land. Land is becoming very expensive, and, as I said, the oxidation ponds take up a lot of area.*

Q. You have mentioned that waste water can be re-used. How?

A. *Waste water can be re-used for the following: (1) Irrigation for agricultural purposes; (2) irrigation for municipal parks, hotel lawns, tree planting etc. and (3) industry. Water is used for cooling purposes in some industries. This water can be re-used many times. (4) You can even use recycled water for drinking, if it has been extensively treated. Treated water can be put back into the dam, and then drawn out again and purified for drinking. Or the water can re-charge the underground aquifers.*

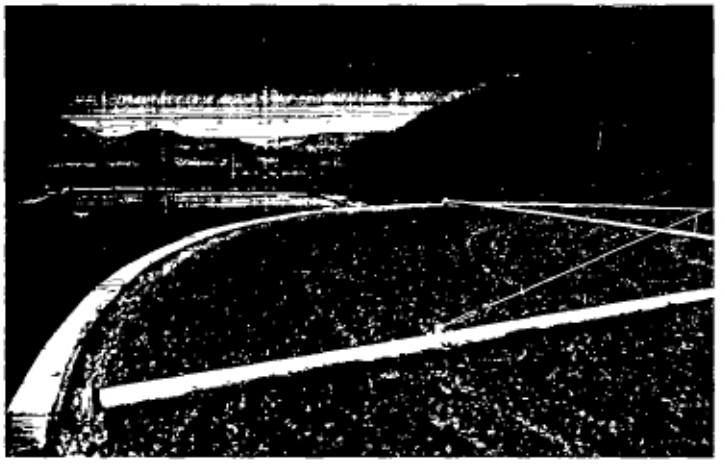
Q. How big are the ponds which are in use now?

A. *There are many ponds. The ponds in Broadhurst discharge into the Phakalane reservoirs which are as big as a lake and provide a home for many water birds and fish. Even though the ponds come from waste water, they are useful. They are also beautiful.*

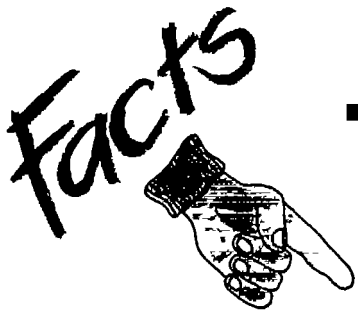
Q. What sort of jobs are available in waste water treatment?

A. *The new system which will be installed at the Gaborone City Council is complicated and will need a laboratory and equipment. That means we will need environmental engineers, mechanical engineers, chemists for laboratory work, technical officers with training in water and waste water management, and technical assistants and labourers - as well as plumbers, plant operators and so on.*

Safely disposing of waste water is important for our environment and many people will be needed to do this work - both women and men.

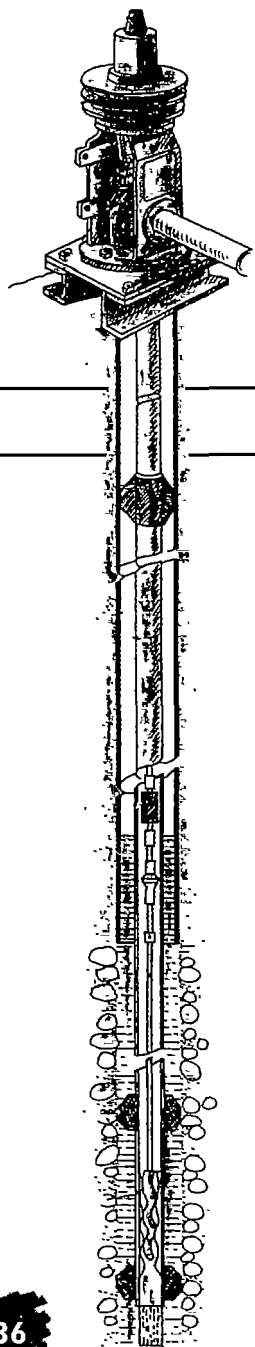


There are many systems for waste water treatment The illustrations show parts of a system in Lobatse.



Training Paths

In this section of your career guidance book we will present some (but not all) of the important training institutions and training paths that are related to water and environmental engineering. On page 42 in this book you can find addresses and telephone numbers of the institutions so that you can contact them for further information and guidance.



Today most training for jobs in the water and environmental engineering sector can be done in Botswana. There is almost no need to send students abroad for training. It is mostly from the level of master's degree and upwards that you may need training abroad.

Training of Artisans

An artisan is a person who has been trained for a specific craft. There are a number of different trades in which a person can be trained to become an artisan. The ones related to our sector are: water supply operator, general mechanic, borehole mechanic, heavy plant mechanic, pipefitter, plumber, bricklayer, welder and machine fitter.

Artisan or craft training organized through Vocational Training Centres (VTCs) and Madirelo Training and Testing Centre (MTTC) is based on the idea that you are given all the necessary practical on-the-job training by your employer, combined with a period of training in an institution to strengthen your theoretical knowledge of the trade.

MTTC organises short Skills Improvement Courses, normally six weeks, ending with a trade test giving you a recognised Trade Certificate.

VTCs give a four-years-long apprenticeship training leading to a National Craft Certificate, NCC, which is the highest award you can get in artisan training in Botswana.

Brigades supply full time training leading to trade C or B certificates.

Brigades

Brigades training combines education with production. Brigades are small businesses and technical institutions which are not part of the government. The Brigades' training costs are, however, covered by the Botswana Government.

There are, at present, 27 active training Brigades in the country. Together they offer a wide range of courses like plumbing, bricklaying, and general maintenance mechanics. However, each

Brigade offers only a selected number of courses. Apply directly to the Brigade centre which offers the course which interests you.

Trainees who have a JC and who have worked for two years after obtaining the B certificate can further their studies to NCC level in one of the VTCs, if they have obtained an apprenticeship contract with an employer.

Vocational Training Centres

The six Vocational Training Centres fall under the Ministry of Education. The VTCs are situated in Maun, Selebi Phikwe, Palapye, Gaborone and Jwaneng - plus the Automotive Trades Training School (ATTS) in Gaborone. (The name of ATTS will be changed to Metal Trades Training School - MTTS).

The VTCs offer training in a wide range of trades up to NCC level.

Madirelo Training and Testing Centre

The Madirelo Training & Testing Centre (MTTC) is situated in Gaborone and falls under Ministry of Labour and Home Affairs. MTTC is responsible for all trade tests in the Brigades, the VTCs and for qualified individuals from work places.

Application for craft or artisan testing should be made to the Director of Apprentice Training at the MTTC. Applications can be made at any time of the year. However, an apprenticeship contract always starts on the first of July.

Artisan Training Examples

To give you a better idea what artisan's training is about, here are two examples from the NCC courses offered for Pipefitters and Borehole Mechanics. The courses follow a national training standard that is regularly revised so as to match the demands within the trades.

Pipe Fitters NCC Course

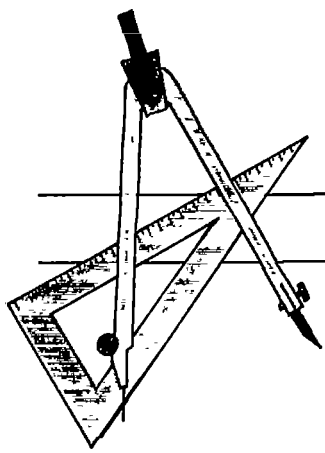
This course covers a wide range of topics. Here are some of the important ones:

- Working Safety. This includes workshop rules and regulations, safe handling of tools and equipment.
- Materials. This includes the characteristics of different types of pipes, building and pipefitting materials, storage tanks, different types of valves.
- Tools, Machines and Instruments. Here you will learn how to use pipe cutters, thread machines, drill machines, hacksaw, bending machines, welding equipment, concrete mixing machines and vibrators.
- Trade Methods and Techniques. This major part of the course involves methods and techniques used for the layout, installation, testing, operation, maintenance and repair of water supply systems. It includes laying of different types of pipes, installation of valves, storage tanks, stand pipes and water meters. The course also includes basic knowledge about surface and ground water. It covers waste water treatment systems: how to lay sewer lines, how to install manholes for private connections, cleaning of sewers.
- Drawing Techniques. Here you will learn how to read technical drawings and understand symbols used in the trade.
- Trade Specifics. This part of the course deals with regulations and standards for water supply and waste water schemes. It also includes how to set up specifications and bills of quantities, cost and material estimations. You will also learn the basic principles of hydraulics and mechanical engineering.

Borehole Mechanic NCC Course

The course covers a wide range of topics. Here are some important ones:

- Working Safety. You will learn safety aspects on working out in the field at the boreholes and in the workshop.
- Trade Technology and Theory. You will learn the basics about ground water and how to monitor the ground water in boreholes; how to select, install, test, maintain and repair all kinds of pumping equipment (hand pumps, pumps powered by diesel engines, wind mills, solar power, electric motors); how to construct pump houses and store houses; how to protect the ground water from pollution and how to monitor the water quality. You will also become familiar with desalination technology which makes it possible to use salty water. The training also includes a lot of metal work like drilling, cutting and welding.
- Mathematics and Physics. You need to know these subjects in order to calculate power, transmission, pressure, velocity and other specific needs.
- Drawing Techniques. See the description of drawing techniques under "Pipe fitting NCC Course."
- Associated Studies. These include topics like: health and sanitation related to water supply; practical planning, administration and reporting of water services; legal aspects of water supply; estimates and budgeting; supervision and development of staff; logbook keeping and analysis of logbook information.



Training of Technicians

Relevant technician training is offered at both the Botswana Polytechnic and the Institute of Health Sciences in Gaborone.

The Polytechnic

The Polytechnic has three engineering departments which offer courses in civil, electrical and mechanical engineering. Each of these departments offers *Technician Certificate* and *Technician Diploma* courses.

The Polytechnic also offers a Bachelor of Engineering programme in conjunction with the University of Botswana (see the section of this chapter dealing with professional training).

The Polytechnic can also provide short training programmes for people already working in the water sector, often in co-operation with the employers. For example, they offer courses in concrete technology and practical skills in electrical engineering, both of which are useful to people employed in the water sector.

There is a wide range of courses at the Polytechnic that have something to do with the water, waste water and environmental sector. Electrical engineering involves electronics used in control panels for submersible pumps and knowledge of mechanical engineering is needed when you deal with engines and engine installations.

The courses shown below, however, are those which are directly related to the water sector. Both are offered in the Civil Engineering Department.

Water Engineering Technicians (WET) Diploma Programme (2 years)

Course Content:
- mathematics & geometry;
- physics, chemistry & mechanics;
- building construction & drawing;
- survey and map reading;
- properties of materials;
- technical English;
- hydrology;
- hydraulics;
- water engineering;
- environmental sanitation;
- water and wastewater systems management.

Normally students attend a 2 - 3 months´ field camp between the two years of the programme.

Entrance requirement: a Cambridge Overseas School Certificate with credits in mathematics, science and English.

Those graduating from this course may start a career in the public or private sector, and after at least one year of experience may get admission to a Higher National Diploma programme.

Higher National Diploma in Water and Environmental Engineering (2 years)

Course Content:

Year one:
- mathematics;
- construction and structures;
- geotechnology;
- economics & management;
- computer applications;
- environmental chemistry & biology;
- principles and practice of public health;
- hydraulics;
- water resources.

Year two:
- water and waste water treatment;
- water distribution & waste water collection;
- design of water & waste water systems;
- waterquality monitoring and pollution control;
- environmental systems management;
- water supply and sanitation for small communities;
- miscellaneous environmental engineering practices;
- field camp, field visits and seminars;
- students are also required to complete a project.

Entrance requirement: must have passed WET Diploma well and have at least one year post-diploma experience

HND graduates may obtain positions in the public or private sector, and may also gain admission to a bachelor's degree programme in engineering at the Polytechnic or a specialised degree programme in water/environmental engineering at universities abroad.

Institute of Health Sciences

The Institute of Health Sciences (IHS) offers a number of technician-level programmes in different health sciences.

Environmental Health Officers work to keep the environment clean and to control communicable diseases. They inspect food, the places where people live and work, and they try to control and reduce environmental and occupational hazards. An important part of this job is the protection of the water supply and correct disposal of waste water.

Environmental Health Officers Diploma Programme (3 years)

The course content is very broad but subjects studied which are relevant to the water sector include:

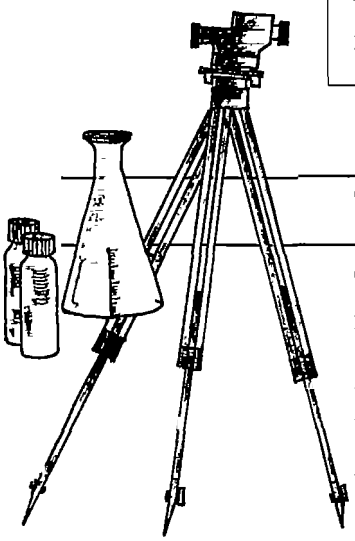
- problems with community water supply;
- problems with collection, storage and disposal of waste;
- pollution from industry;
- water-borne communicable diseases;
- many different subjects concerning hygiene.

Two months in each of the second and third years involve full-time practical training under the supervision of qualified Environmental Health Officers.

Entrance Requirement: a first or second class Cambridge certificate with passes in English, mathematics and any two of the following: physics or physical science, chemistry, combined (integrated) science, or biology.

Places where an Environmental Health Officer can work are: Ministry of Health; District, Town and City Councils; and private industry.

After completing training as an Environmental Health Officer, you can get specialist training in such areas as food technology, environmental pollution and occupational health.



Training of Professionals

The water and environmental engineering services in Botswana call for professionals in various fields. For all of these fields, you need to have passed Cambridge with very good grades, especially in mathematics and science subjects.

At present, to get a professional degree you must go from COSC to the University of Botswana's Pre-Entry Science Course (PESC). However, this may change, so you should ask your teacher or find out from the university what to do when you are ready to apply for professional training.

Common professional fields are:

- **Electrical-Mechanical Engineering** professionals are concerned with design, installation, maintenance and repair of pumps, engines, drilling rigs and other equipment.
- **Water-Waste Water Engineering** professionals deal with water supply and wastewater development planning and implementation. They also deal with repair and maintenance of all the civil works such as pipe-lines, sewer lines, treatment plants, dams and other types of storage.

- **Public Health Engineering** professionals have a wide range of duties. Among them are water quality monitoring, planning and implementation of solid waste services.
- **Hydrogeology** professionals are mostly concerned with the planning, exploration, development and management of ground water resources.
- **Hydrology** professionals collect and analyze data used for planning of the use of surface water resources (i.e. rainfall, water in rivers, lakes and dams).
- **Water Chemistry** staff deal with water and waste water sampling, analysis, quality control and protection of water resources.
- **Environmental Monitoring** professionals are involved with the environmental impact assessments and monitoring of the effects of major projects.

There are, of course, other professions, outside the science fields, involved in the water sector. For example, lawyers are needed because sometimes there are disputes over the right to use water, and there are laws which govern the use of water. Accounting, management, and similar professions are also needed for support.

For detailed information on the various degree programmes you should contact the University or the Polytechnic. Here is some additional information on the Bachelor of Engineering programme.

Bachelor of Engineering Degree Programme in Civil Engineering

The Bachelor of Engineering degree programme is a full-time programme extending over five academic years. It includes a total of 40 weeks practical at a work place.

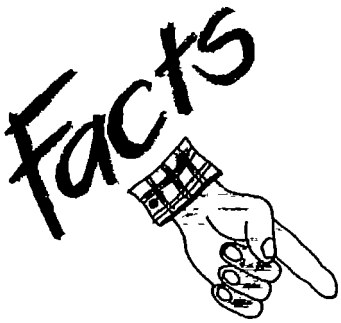
The first year is offered by the Faculty of Science of the University of Botswana. At the end of that year, in order to be allowed to continue, you must have obtained good marks in mathematics and physics, plus a pass in either chemistry or biology. The remaining parts are offered at the Botswana Polytechnic.

The two 20-week periods of Industrial Training will take place between the second and third year, and the third and fourth year.

The Civil Engineering degree programme is designed to equip the student with a broad and thorough understanding of the planning, design, construction and maintenance of major works of public utility. These include roads, railways, dams, bridges and systems for water supply and drainage.

The programme gives the requirements of career routes to professional registered engineer status. However it does not offer specialization in any area. It contains only a few courses related to water, such as hydraulics and water engineering, which are taken by all civil engineering students.

After graduation, a Civil Engineer can go for a master's degree programme in water/environmental engineering, preferably after two years of experience in the water industry.



How to Get Financial Help

Education is very expensive and you may need to get financial help.

Most artisan's training is sponsored by the government. If you have a job already, your employer can sponsor you.

For technician's and professional level training it may be necessary to apply for a grant (i.e. to have your expenses paid by government) or a loan (the money will be paid for you but you will have to pay it back when you have completed your training) from the Goverment Grant-Loan Scheme.

The Grant-Loan Scheme is meant to help the country get Batswana who have the skills which are needed by encouraging them to train in areas where there is a shortage of local skills.

There are different categories within the Grant-Loan scheme. Category I includes areas where there is an extreme shortage of trained Batswana, and it includes science and technical fields. For students in Category I, if they meet all the requirements, they will receive a grant covering both tuition (the amount which has to be paid to the school) and maintenance (the money you need for your food, housing etc.).

Fields of study presently in Category I include engineering, land surveying, and hydrology.

Category II courses qualify a student for a 100% grant for tuition and 50% on maintenance. The other 50% of the maintenance cost can be financed by a loan. This means that you must work in Botswana for a certain amount of time to repay the loan. Category II jobs presently include chemistry, agricultural science, and geology.

There are, in total, five categories; but most of the technical jobs in the water sector fall under Categories I and II. Your teacher has more information on the Government Grant Loan Scheme.

Remember:

Even if you are in Category I, you do not automatically receive a grant. You have to show that you are serious and that you have a sense of responsibility. The same is true if you are being sponsored by your employer. No employer wants to squander money on someone who is not willing to give his or her best.

Addresses

For further information and details on how and when to apply, contact the relevant institution:

- **University of Botswana**
  Private Bag 0022, Gaborone
  Tel . 35 11 51, fax: 35 65 91
- **Botswana Polytechnic**
  Private Bag 0061, Gaborone
  Tel : 35 23 05, fax: 35 23 09
- **Institute of Health Sciences**
  P:O Box 985, Gaborone
  Tel 35 30 33, fax· 30 09 35
- **Madirelo Training & Testing Centre**
  P O. Box 10087, Gaborone
  Tel.. 35 63 18
- **BRIDEC**
  (co-ordinator of Brigades)
  Private Bag 0062, Gaborone
  Tel · 35 25 89, fax: 31 31 91

You can also contact

- **Bursaries**
  (Department of Student Placement and Welfare)
  Ministry of Education
  Privat Bag 005, Gaborone
  Tel · 31 27 06, fax. 31 28 91

Glossary

Here are some definitions of words used in this book which you may not know. If there are other words you do not understand, look in a dictionary or ask your teacher.

acquires: gets

activated: made active. Activated sludge is sludge in which some activity is taking place - i.e. it is changing.

aquifer: natural underground feature, such as porous rocks, which store water, or through which water flows.

bachelor's degree: the first degree given when a person graduates from a university. One can get a Bachelor of Science degree, or **B.Sc.**; or a Bachelor of Arts, **B.A**. Most scientific and technical jobs require a science degree.

bacteria: very small living things, which consist of only one cell. Many diseases in human beings, animals and plants are caused by bacteria.

bacteriologist: a scientist who specialises in the study of bacteria.

bowser: a large barrel or tank, mounted on wheels, used for carrying liquid such as water.

chemistry: the study of chemicals. A scientist who specialises in knowlege about chemicals is a **chemist.**

committed: promised or dedicated to something.

commitment: a pledge or promise to do something. A person who is committed to her or his job takes the job seriously and feels it is important.

consultancy: a special study done by a **consultant** (or more than one consultant) who has expert knowledge about the subject.

decompose: to decay or rot.

desalination: the process of removing salt.

determination: having a firm goal; the ability not to give up easily.

ecosystem: the natural environment - air, land, water, climate etc. - and all the living creatures in it, including plants, animals and human beings, all depend upon each other. Everything in the environment, including living things, affects everything else. This makes up a system, which is called an ecosystem.

effluent: something that flows out of some place.

engineer: a person who has qualified in the study of **engineering**, which concerns the design and production of systems that work. There are many different branches of engineering. Mechanical engineering has to do with the design of machines. Environmental engineering concerns the design of systems to make the environment clean, healthy and pleasant to live in.

ephemeral: something which lasts a very short time. For example, pans in the Kgalagadi have water in them only a short time after a rain. They are called *ephemeral* sources of water.

evaporate: to go from a liquid state to a gaseous state. For example, when you boil water for a long time, all the water disappears into the air by evaporating. Water also evaporates when it gets hot under the sun.

gender: the culturally expected roles, attitudes and behaviour of females and males (women, girls, men & boys) as defined by society. Gender also refers to the unequal relations between females and males.

geology: the science of the earth: How it was formed, how rocks

were formed, the history of the earth etc. There are many specialized fields within geology, such as **hydrogeology**, the study of the earth's water supply; and **geophysics,** the physics of the earth.

groundwater: water which is stored, or flows under the ground. The rocks which store underground water are called aquifers.

job description: a description of what an employee is supposed to do in a particular job. Most jobs, especially those in government or other large organisations, have a written job description which a person can read to find out what type of work is involved in that job.

magnetic field: the portion of space near a magnetic body (or a body carrying a current) in which magnetic forces can be detected.

oxidation: the process in which oxygen combines with something else. For example, iron, such as in a cast iron pot combines with oxygen to form rust.

pollute: to pollute something, such as the water supply or the environment, is to make it dirty. The dirt or substance which makes it dirty is called **pollution.** Pollution can be impossible to see without the help of special equipment. For example, pollution can be caused by bacteria, which are too small to see without a microscope. Or it can be made of poisonous chemicals, such as the gases which pollute the air when such things as plastic bags and rubber tyres are burned. Bacteria are one example of a **biological pollutant**. Harmful chemicals in the environment are **chemical pollutants.**

potable: drinkable; clean, free from pollution and free from bad taste and bad appearance.

profession: an occupation, such as a career, to which a person devotes care, attention and study. It is different from a job, which can be temporary and casual.

professional: a professional person is one who has a profession.

rainwater catchment: rainwater harvesting: a method of catching the rain that falls on a roof or other flat surface, and storing it in a tank or dam for future use.

recycle: to use a resource, such as water, or glass bottles, or metal cans, in such a way that the resource can be used over and over again.

relevant: fit for a particular situation or occasion.

satellite: a space vehicle which goes around the earth, very high above the earth's atmosphere.

sludge: something like mud which settles at the bottom of a sewage pond.

solid waste: any kind of rubbish which is not liquid, such as tin cans, plastic, rubber tyres, building rubble etc.

stabilization: the process by which something becomes stable.

surface water: water which is found on the surface, such as a pond, a river or a lake.

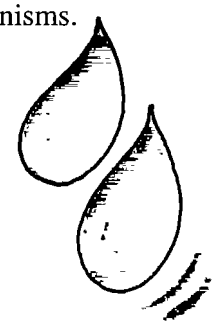
surveying: making measurements and observations of land, using special instruments and the mathematical principles of geometry and trigonometry.

sustainable: something which can be continued indefinitely. Sustainable development is development which does not use up resources etc., so that the resources do not run out and cause the development to stop.

technician: a person skilled in the **technical** details of a job or trade, especially something which pertains to mechanical or practical types of work.

treated water: water which has been treated in some way, such as by adding chemicals to purify it, in order to make it suitable for use.

waste water: liquid waste, including sewage and other types of dirty water such as water polluted with chemicals or disease organisms.



Production Notes

This book was produced by combining the competence and efforts of many people: members of the Reference Committee and the Project Group, guidance teachers, students, employees within the water sector and members of the technical production staff.

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Members of the Reference Committee and the Project Group were: Joyce Maphorisa, Motshwari Mabote (chairpersons), Koti Molefi and Manini Nyati, MOE; Sian Griffiths (secretary), TS; Paivi Keskinen, SIDA; Maria Overeem, BRIDEC; Joe Ntshambiwa, DWA; Wame Mosielele, WUC; Per Järtby and Pauline Makepe, UB; K. Jayaraman, DLGSM/Polytechnic; Elsie Alexander, local consultant; Ellen Drake and Bengt Carlsson, SIPU International.

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"I have not gone much to the lands the last few years. Last year I did not go at all – there was no water.

Sometimes we go for days without water there. We had to ask for the donkey cart from the neighbours, to put drums on the donkey cart and to travel long, far across the railway to get water from a pan that still held water, but it is not clean water."

– quotation from a secondary school student in Botswana

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A TEACHERS' GUIDE TO WORK WITH WATER

PUBLISHED BY THE GOVERNMENT OF BOTSWANA
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FOREWORD

The Teachers' Guide to Work with Water provides information and ideas for teachers and contains examples of different activities which students can undertake which have been designed to stimulate their interest in the water sector and its opportunities. It also contains a number of activities which focus on gender issues. The water sector is only one of many sectors of the Botswana economy where women are under-represented, especially in technical positions. It is hoped that, through participation in these activities and the discussion which they might generate, more young women might be encouraged to consider taking up careers in the water sector.

Many of the activities suggested require students to conduct their own research. Some of them require that students leave their classrooms - perhaps to interview someone working in the water sector, to examine a nearby river or borehole, or to visit a water treatment plant, for example. The **Teachers' Guide** does not provide 'ready-made' answers to the questions which students may ask. Instead, it encourages active learning, through participation and investigation.

It is expected that teachers will adapt the various activities and exercises provided to suit their own needs and the interests of their students.

The material for the **Teachers' Guide** originated from a number of workshops. Two workshops were held for teachers, in January and April 1994. The teachers visited water sector organisations, put together ideas, and undertook various activities with their students which provided the basis for the activities provided in the **Teachers' Guide**. A third workshop was held in May 1994 at which members of a smaller project group developed the material. The material was then compiled and edited. Project management was provided by SIPU International and the project was funded jointly by the Botswana Government and the Swedish International Development Authority (SIDA).

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CONTENTS

What is Gender?

It is important to make a distinction between **gender** and **sex.**

Sex identifies the *biological* difference between women and men. It is something that can not be changed. **Gender** identifies the *social* or *cultural* relationships between women and men. It, therefore, refers not to women or men but to the relationship between them, and how that relationship is socially determined or perceived. Thus gender is a dynamic concept, it changes as a result of modernisation, education, and higher levels of economic development. Since gender is socially determined, it is acquired and can be changed.

The nature of the relationships between women and men can be discussed on three levels; the domestic, the educational and the macro-economic.

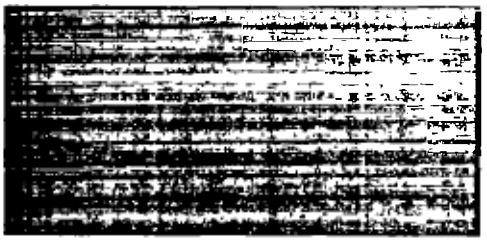
Gender differences and attitudes begin in the home. It is the family which assigns to the child his or her first roles and responsibilities. At home, the child learns what is considered to be appropriate for girls and boys. Traditionally in Botswana, the girls were responsible for cooking, fetching water, washing clothes and harvesting, while the boys fed and herded cattle, ploughed the fields and supervised work. This traditional structure has begun to change due to the fact that women have started to work outside the home and also because an increasing number of households are headed by single women today.

School is another social institution that plays a major role in shaping and changing gender attitudes. Teachers have a strong influence in terms of how the students act and in determining the roles which students play in the classroom. Research has shown that teachers give more encouragement to boys in science subjects. Text books in these subjects have usually been written by men, the content is often defined by men and is intended for male students. Science text books tend to contain more illustrations of men than women. Perhaps it is due to these factors that more boys perform well in science subjects than girls and that more boys choose science or mathematics-based careers.

Traditionally, women did not participate in the economic life of the country. Today, however, it is recognised that development is more efficient through women's economic contribution. At this level, gender refers to the structural relationship of inequality between women and men as it is manifested in the different sectors of the economy, such as in education and employment. Inequalities are reinforced by traditional stereotyped attitudes, expected roles of women and men in society, discriminatory legislation and development policies. A prominent example is the gender imbalance between women and men in scientific and technical fields or sectors, such as the water sector. Botswana needs both women and men in these fields.

This first section of the **Teachers' Guide** focuses on gender issues. It contains a number of activities for students which are designed to make them more aware of gender issues. At the same time, both students and teachers can examine their own attitudes towards gender issues.

It is important to remember that as a teacher you influence and can change the attitudes held by your students and their parents. You can play an important role in influencing girls to study science and mathematics in order that they may consider taking up careers in scientific or technical fields.



Making a Survey of Your Students' Attitudes

TEACHER

Questionnaires

As a teacher, particularly if you are a guidance teacher, it is important to know your students well. One of the ways in which you can obtain useful information about your students, their attitudes and their aspirations, is by asking them to complete questionnaires. Similar questionnaires can be used to find out more about your students' parents or about your own colleagues - those who have some kind of influence over your students.

To make the best of the book **Work with Water**, it could be helpful to ask your students some questions about their attitudes toward certain school subjects, towards certain careers or types of work, toward gender issues, and so on. By asking questions about your students' backgrounds and home environments, you might get some clues as to what or who are influencing them or shaping their attitudes.

Aim: To examine:

students attitudes regarding girls or boys doing science, maths or technical subjects at school as well as choosing scientific or technical careers.

Objectives: To examine:

a) how being a boy/girl affects a student's choice of school subjects;

b) how being a boy/girl affects a student's choice of career;

c) to what extent the attitudes of teachers or parents influence students' choices.

Sample Questionnaires

The sample questionnaires provided, one for boys and one for girls, are examples that may help you when preparing your own. It is suggested that you adapt the questions to suit your own needs. Do not include more questions than necessary. Be clear about what you want to find out.

Avoid overloaded questionnaire items.

Example of a questionnaire item which is overloaded:

Do you think that your performance in science and mathematics is affected by the fact that you are a boy/girl?

A better questionnaire item would be:

For each of the following statements tick the one which best indicates your response:

	Strongly agree	**Agree**	**Disagree**	**Strongly disagree**
Boys have more problems in studying mathematics				
Science and technical subjects are mainly for boys				
My performance in mathematics is affected by the fact that I am a boy				

Interviews

You could follow up the questionnaire exercise by interviewing a handful of students to get a clearer picture of their attitudes and the factors which have influenced them in forming their opinions.

Group Discussions

Group discussions may also provide an opportunity for students to exchange ideas. Listening to fellow students can be a very important learning exercise for students; some may even find themselves questioning their own attitudes after considering those of their fellow students.

STUDENT

Questionnaire: Boys

All information disclosed in this questionnaire will be treated as confidential and will only be used for the purposes of the survey. Names will not be used.

1. Personal information:

a. Form: _____ b. Age: _____

c. Sex: BOY _____ d. Home Village/Town: _____

e. When you are at home, with whom do you stay? _____

f. What does the person you stay with do? _____

2. Family Details:

Give details of your parents' education by ticking in the correct box:

Education	Mother	Father
No formal education		
Up to Standard 7		
Up to JC		
Up to Cambridge		
Universtity Education		
Other (specify)		

3. Home Environment

a. At home I do the following chores:
(tick in the most appropriate box for each chore)

Chore	Never	Sometimes	Very Often
cook food			
wash clothes			
make fire			
clean the house			
look after the children			
look after the livestock			
fetch water			
fetch wood			
work in the garden			
mend clothes			
wash dishes			
wash the car			

b. At home my **sister/s** do the following chores:
(tick the most appropriate box for each chore)

STUDENT

Chore	Never	Sometimes	Very Often
cook food			
wash clothes			
make fire			
clean the house			
look after the children			
look after the livestock			
fetch water			
fetch wood			
work in the garden			
mend clothes			
wash dishes			
wash the car			

c. Have your parents ever given you advice about which subjects to choose at school?

Yes ☐ No ☐

d. Have your parents ever given you advice about which career to follow?

Yes ☐ No ☐

e. What do your parents want you to be when you finish school? _____

_____

f. Who, apart from your parents, do you discuss careers with? _____

_____

STUDENT

4. Subject Choice

a. Why did you choose the subject combination which you are now studying?

_____

_____

_____

b. Do you think that being a boy influenced your choice of subjects?

Yes ☐ No ☐

Why? _____

_____

c. Which are your favourite subjects at school?

1. _____ 2. _____ 3. _____

d. Why do you like these subjects?

_____

_____

_____

e. For each of the following statements tick the one which best indicates your response:

	good	**average**	**poor**
My performance in mathematics is			
My performance in science is			

f. for each of the following statements tick the one which best indicates your response:

	strongly agree	**agree**	**disagree**	**strongly disagree**
Boys have more problems in studying mathematics				
Science and technical subjects are mainly for boys				
My performance in mathematics is affected by the fact that I am a boy				

5. **Career Choice**

STUDENT

a. What do you want to be when you finish school?

_____

b. Explain why you have chosen that career: _____

_____

_____

_____

c. Which subjects do you need to study at Cambridge level in order for you to be able to follow that career?

_____

d. Where would you be able to receive training for the career you have chosen?

_____

_____

e. Where would you prefer to work? (Choose from the options given below):

i) Urban area	☐	Rural area	☐
ii) Indoors	☐	Outdoors	☐
iii) In an office	☐	Practical work	☐

f. Do you think that there are certain jobs which are better suited for men and others which are better suited for women?

Yes ☐ No ☐

If you answered yes, give three examples of jobs which you think can be better done by men and three which you think can be better done by women.

i) Three jobs for which men are better suited:

1._____

2._____

3._____

ii) Three jobs for which women are better suited:

1._____

2._____

3._____

STUDENT

Questionnaire: Girls

All information disclosed in this questionnaire will be treated as confidential and will only be used for the purposes of the survey. Names will not be used.

1. Personal information:

a. Form: _____ b. Age: _____

c. Sex: GIRL d. Home Village/Town: _____

e. When you are at home, with whom do you stay? _____

f. What does the person you stay with do? _____

2. Family Details:

Give details of your parents' education by ticking in the correct box:

Education	Mother	Father
No formal education		
Up to Standard 7		
Up to JC		
Up to Cambridge		
Universtity Education		
Other (specify)		

3. Home Environment

a. At home I do the following chores:
(tick in the most appropriate box for each chore)

Chore	Never	Sometimes	Very Often
cook food			
wash clothes			
make fire			
clean the house			
look after the children			
look after the livestock			
fetch water			
fetch wood			
work in the garden			
mend clothes			
wash dishes			
wash the car			

b. At home my **brother/s** do the following chores:
(tick the most appropriate box for each chore)

STUDENT

Chore	Never	Sometimes	Very Often
cook food			
wash clothes			
make fire			
clean the house			
look after the children			
look after the livestock			
fetch water			
fetch wood			
work in the garden			
mend clothes			
wash dishes			
wash the car			

c. Have your parents ever given you advice about which subjects to choose at school?

Yes ☐ No ☐

d. Have your parents ever given you advice about which career to follow?

Yes ☐ No ☐

e. What do your parents want you to be when you finish school? _____

_____

f. Who, apart from your parents, do you discuss careers with? _____

_____

STUDENT

4. Subject Choice

a. Why did you choose the subject combination which you are now studying?

_____

_____

_____

b. Do you think that being a girl influenced your choice of subjects?

Yes ☐ No ☐

Why? _____

_____

c. Which are your favourite subjects at school?

1. _____ 2. _____ 3. _____

d. Why do you like these subjects?

_____

_____

_____

e. For each of the following statements tick the one which best indicates your response:

	good	**average**	**poor**
My performance in mathematics is			
My performance in science is			

f. for each of the following statements tick the one which best indicates your response:

	strongly agree	**agree**	**disagree**	**strongly disagree**
Girls have more problems in studying mathematics				
Science and technical subjects are mainly for girls				
My performance in mathematics is affected by the fact that I am a girl				

5. Career Choice

STUDENT

a. What do you want to be when you finish school?

_____

b. Explain why you have chosen that career: _____

_____

_____

_____

c. Which subjects do you need to study at Cambridge level in order for you to be able to follow that career?

_____

d. Where would you be able to receive training for the career you have chosen?

_____

_____

e. Where would you prefer to work? (Choose from the options given below):

i) Urban area ☐ Rural area ☐

ii) Indoors ☐ Outdoors ☐

iii) In an office ☐ Practical work ☐

f. Do you think that there are certain jobs which are better suited for men and others which are better suited for women?

Yes ☐ No ☐

If you answered yes, give three examples of jobs which you think can be better done by men and three which you think can be better done by women.

i) Three jobs for which men are better suited:

1._____

2._____

3._____

ii) Three jobs for which women are better suited:

1._____

2._____

3._____

STUDENT

Worksheet

How Many Women?

On page 23 of **Work With Water** you will find information on how many women are employed in four different water sector organisations.
Here is a table presenting the same information. However, this table has two additional columns which you are to fill in yourselves. You are expected to calculate the total number of first women and then men working in each of the organisations, followed by the grand total of employees (men plus women) within each organisation.

No of employees (April 1994)	Water Utilities Corporation		Department of Water Affairs		Department of Geological Surveys		Local Authorities		Total		Grand Total
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	
General Administration	98	266	147	39	1	1	18	32			
Workers	1	237	3	1960	2	26	198	1330			
Artisans	-	65	1	83	2	8	4	57			
Technicians	18	53	2	90	-	5	2	55			
Professionals	8	27	5	40	1	15	-	8			
Total											
Grand Total											

Once you have completed the table, answer the following questions using the figures given in the table.

1. What percentage of employees in the water sector work for

   a) WUC?
   b) DWA?
   c) DGS?
   d) Local Authorities?

2. Make a pie chart of your findings in answer to question 1.

3. What is the ratio of women to men in the water sector?

4. What percentage of the employees are women in

   a) WUC?
   b) DWA?
   c) DGS?
   d) Local Authorities?
   e) The whole sector?

5. a) How many women in the water sector are technicians?

   b) How many more women need to be employed as technicians in order that 50% of the technicians are women?

   c) How many more women need to be employed as technicians in order that 20% of the technicians are women?

6. Why do you think so few women are working in the water sector or technical careers generally?

Social Roles and Careers: Activities

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Below are listed a number of different activities which students can carry out which will help them to examine the social roles which men and women perform - the expectations which society places on men and women to behave in certain ways in certain situations, and in particular with regard to careers.

STUDENT

1. Interview a man or woman who does not follow traditional male/female lines of house hold duties. Try to discover why the individual has developed his/her own way of attending to household responsibilities, rather than following traditional divisions of tasks and how he/she feels about the role he/she plays.

2. Survey your classmates in terms of the subjects girls have chosen to study versus those that boys have chosen. Make a chart similar to the one shown below. Add any other subjects that are done by your classmates. Compare the number of boys and girls taking each subject.

Subject	Girls	Boys
Home Economics		
Design and Technology		
Physics		
Chemistry		
Biology		

Discuss the results of the survey with your classmates.

3. Have you ever noticed a teacher responding differently to girls or boys in class? If you have, give examples of how the teacher responded differently to the boy/s or girl/s. Discuss how this might influence boys' or girls' behaviour and performance in school.

4. In the table below, list three occupations which you might be interested in doing. What abilities and interests are required for these occupations?

List of Occupations	Required Abilities and Interests
a.	
b.	
c.	

Do you think that men have abilities which women do not or that women have abilities which men do not? Do you think that any of the abilities which you have listed in your table are more commonly found amongst men or more commonly found amongst women?

5. Make a list of occupations related to the water sector. State whether mostly men or women, or both, are employed in those occupations. Discuss why some of the occupations are considered more appropriate for men and why some are considered more appropriate for women. What do you think?

6. Interview a woman or a man who is in an occupation that is not considered traditionally female or male. Discuss with the person how he/she feels about being in an occupation that is dominated by the opposite sex. Why did this person choose this occupation, despite the fact that it was not traditionally occupied by people of his/her sex. Find out if the person ever feels discriminated against at his/her workplace on the basis of sex.

   After interviewing this person, consider whether your own ideas or feelings about the occupation which that person holds have changed or not. If your views have changed, how have they changed?

How to Organise Student Research Activities

What is Research?

When we carry out research, we are carrying out **an investigation** - either because we want to discover something new or to establish new facts, or because we have some information on a given subject and are looking for more information relating to the same subject.

Work with Water does not provide all the information about the water sector or careers which involve working with water. Students should be encouraged to research or to find out more information about the water sector organisations, training institutions or particular careers which interest them most.

How to Conduct or Organise Research

Where and How can students get hold of information?

- From libraries: by reading relevant books, magazines, newspaper articles or advertisements, prospectuses for training institutions, and other relevant career guidance materials that are available.
- By visiting organisations or institutions. (See section of the **Teachers' Guide** on how to organise a study visit.)
- By writing to relevant organisations to request information. Students may write to a training institution to request a prospectus or for details of a particular course. They may write to a water sector organisation or employer to request information about that organisation and the employment opportunities there. Even Annual Reports of large organisations such as Water Utilities Corporation contain a lot of useful and interesting information.
- Students may collect information by conducting interviews (of teachers, water sector employers or employees, relevant people in training institutions etc.). If students are unable to visit the relevant organisations in order to conduct interviews, it may be possible for them to post interview questions or written questionnaires to the people whom they want to interview. (See section of the **Teachers' Guide** on how to prepare questionnaires.)

How can Students Write Up or Present the Findings of their Research?

How to prepare a written report after completing a research project:

1. **Subject or Topic**: First they should provide the research project with a title.

   Example: *How is Water Supplied to Our School and Who are The People Involved in the Process of Supplying the Water?*

2. **Statement of Purpose**: There should then be an introductory sentence or paragraph stating the purpose or reason for conducting the research project.

   Example: *The research project was carried out in order to find out how water is supplied to our school and which water sector personnel are involved in the different stages of the process of supplying the water.*

3. **Methodology**: Students should then explain the methodology used, in other words, how the information was obtained.

   Example: *a) The Council Water and Waste Water Department was visited and the Senior Water Engineer and other staff members were interviewed*
   b) The local Water Supply Operator was interviewed.

4. **Findings of the Research**: All the information gathered during the research project which is considered relevant to the topic should be given here.

5. **Conclusion**: Here, students may provide some kind of conclusion or make observations regarding their findings.
6. **References**: Students should provide a list of books or other written materials which they referred to during the course of the research project.

Alternative ways to present the findings of the research project:

1. Students may make oral presentations of their findings to their classmates.
2. Students may make posters which present the findings of their research in an attractive and accessible way.
3. Students may present their findings in the form of role plays.

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SPEEDCOP

Choosing a career is one of the most important decisions of a young person's life. It is also one of the most difficult.

The Guidance and Counselling programme offered in our secondary schools is designed to assist students to cope with and understand their own personal development, the society and environment in which they find themselves, and to plan for and make realistic decisions relating to their own futures.

The career guidance component of the programme seeks to provide students with up-to-date information about the world of work, and about particular careers.

The acronym SPEEDCOP refers to a number of different factors which a student should look at when considering a particular career and trying to match it to his or her own interests and abilities: **s**urroundings, **p**rospects, **e**ntry level, **e**ffects, **d**escription, **c**onditions, **o**rganisation and **p**eople.

Activity using SPEEDCOP

STUDENT

Choose one of the careers offered in the water sector and, using SPEEDCOP as a guide, try to find out more information about that career:

- **SURROUNDINGS** — the environment in which you would work if employed in that career.
- **PROSPECTS** — what the career would lead to.
- **ENTRY & TRAINING** — the basic requirements for entry to the career and training offered.
- **EFFECTS** — how the career would affect your personal life.
- **DESCRIPTION OF THE WORK** — the different duties or tasks to be performed.
- **CONDITIONS** — the conditions and rewards offered eg. hours, pay, benefits, leave entitlement etc.
- **ORGANISATION** — the type of organisation in which you would work eg. school, hospital, factory, mine etc.
- **PEOPLE** — the people with whom you would work eg. children, elderly people, sick people etc.

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How to get Workplace Experience

One of the important stages which students must pass through before they can make wise or appropriate career choices or decisions is career exploration. There are a number of ways in which students can get real workplace experience which can provide opportunity for career exploration.

1. Tirelo Setshaba

Tirelo Setshaba provides many form-five school-leavers with their first experience of the world of work. Participants spend twelve months attached to user departments or organisations. In most instances, they are provided with some form of initial training and then work under the supervision of a qualified person. The Department of Tirelo Setshaba does try to place participants in departments or organisations which are in line with their expressed career interests, although this is not always possible.

Students are asked to put their career interests on the Tirelo Setshaba application forms. When they have been admitted and placed in a certain district, they can discuss their career interests with the Tirelo Setshaba officers there, who will try to assign them accordingly.

Participants who are interested in water sector careers may be placed with District Council Water and Waste Water Departments, the Department of Water Affairs, Public Health Departments, NGOs or other related organisations.They can discuss their particular career interests with their supervisors or the Personnel Officers in the departments or organisations to which they have been assigned. Those people may be able to give them relevant work assignments.

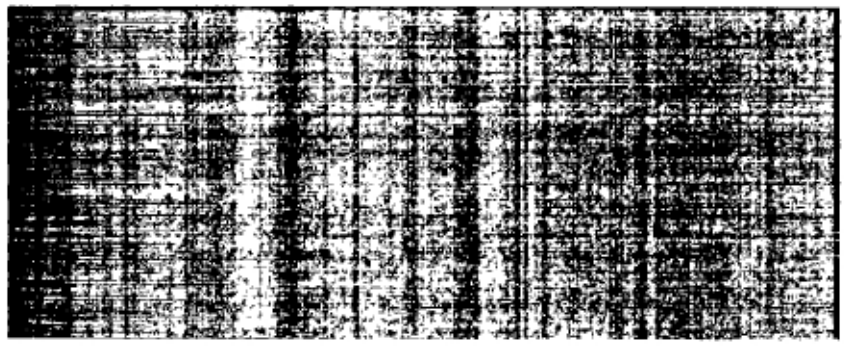
2. Attachments, Job Shadowing, Vacation Jobs etc

It may be possible for some students, either whilst they are still at Secondary School or at a tertiary institution, to spend a short period of time within an organisation or company observing activities that are being undertaken there.

They may be attached to one or several employees or may 'shadow' someone (ie. follow someone closely as he or she is working) and, in this way, can be exposed to the day-to-day realities of the work situation.

In most cases, students are not paid for this type of learning activity but will be rewarded by way of experience acquired.

Students at some tertiary institutions (eg. the Polytechnic or VTCs) undertake industrial attachments as part of their training. Some students at this level also choose to find vacation employment to gain additional work experience. Students undergoing industrial attachments or engaged in this type of temporary employment are usually paid.



Career Opportunities at Different Levels

Below is a list of water sector careers. The list shows the different careers which are available at different levels: **professional** careers are those which require degree-level training, **technician-level** careers require diploma-level training, and **artisan or craft-level** careers are those which can be entered after completing certificate-level training or apprenticeships.

Professional-level Personnel

1. Water & Waste Water Engineer
2. Environmental Engineer/Pollution Engineer/Sanitation or Sewage Engineer
3. Biologist/Bacteriologist
4. Chemist
5. Chemical Engineer
6. Geologist
7. Hydrogeologist
8. Hydrologist
9. Hydro-Chemist
10. Geophysicist
11. Telemetry Engineer
12. Sanitation Officer

Related Careers/Professions:

1. Mechanical Engineer
2. Electrical Engineer
3. Computer Scientist/Analyst
4. Public Health Officer/Sanitation Inspector
5. Cartographer
6. Surveyor

Non-Technical Professionals Working in the Water Sector:

1. General Administrative and Personnel Management Staff
2. Accountants
3. Lawyers

Technician-level Personnel

1. Water & Waste Water Engineering Technician
2. Water Laboratory Technician
3. Rig Technician
4. Environmental Health Technician
5. Telemetry/Instrumentation Technician
6. Driller

Related Careers at Technician-Level:

1. Technicians in Civil, Mechanical & Electrical Engineering
2. Quality Control Technician

Artisan/Craft-level Personnel

1. Borehole Mechanic
2. Pipe Fitter
3. Heavy Plant Mechanic
4. Water Supply Operator
5. Driller
6. Plumber

Related Artisan-Level Careers:

1. Builder/Bricklayer
2. Welder/Fabricator
3. Draughtsperson
4. Machine Fitter

Activities

The list of water sector careers provides a useful reference for both teachers and students. However, it is also suggested that teachers create activities or exercises for students using the list as a starting point. An example of the type of activity which can be created using the list is given on the following page.

STUDENT

Student Activity

Choose five careers from the list and prepare a table similar to the one given below. Complete your table after having found out the necessary information about each of the careers you have chosen

Career	Main Tasks Performed	Where Training Offered	Additional Information
Water & Waste Water Engineer			
Chemical Engineer			
Environmental Health Technician			
Borehole Mechanic			

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Main Steps in Providing Water and Waste Water Services

Water Services	Personnel Involved
1. Water Source Development:	Hydrogeologists, Geologists, Water Engineers, Surveyors, Water Engineering Technicians, Drillers, Water Diviners
2. Raw Water Quality Assessment:	Chemists, Pollution & Water Engineers, Biologists, Water Engineering Technicians
3. Intake Structures/Boreholes:	Water Engineers, Civil Engineers, Borehole Mechanics
4. Pumping Facilities:	Electrical & Mechanical Engineers & Technicians, Water Supply Operators
5. Water Treatment Plants:	Water Engineers, Civil Engineers, Plant Superintendents, Water Engineering Technicians, Biologists, Chemists, Environmental Chemists, Telemetry Technicians, Pipe Fitters, Plumbers, Water Supply Operators
6. Water Quality Monitoring:	Environmental Chemists, Water Engineering Technicians, Laboratory Assistants
7. Water Distribution:	Water Engineers, Civil Engineers, Water Engineering Technicians, Pipefitters, Water Supply Operators, Telemetry Technicians, Plumbers

Water Services	Personnel Involved
1. Waste Water Collection:	Water Engineers, Environmental Engineers, Civil Engineers, Surveyors, Hydrologists, Water Engineering Technicians, Pipefitters, Plumbers, Electrical & Mechanical Engineers, Water Supply Operators, Sewer Maintenance Personnel
2. Waste Water Treatment Plant:	Water Engineers, Environmental Engineers, Chemists, Water Engineering Technicians, Plant Superintendents, Plant Operators, Biologists, Pipefitters, Plumbers
3. Effluent/Treated Waste Water:	Environmental Engineers, Chemists, Biologists, Water Engineering Technicians
4. Waste Water Disposal:	Waste Water and Sewage Engineers, Chemists, Biologists, Water Engineering Technicians, Agricultural Engineers?

Solid Waste Management	Personnel Involved
1. Storage of Solid Waste	Environmental Engineers, Civil Engineers, Engineering Technicians
2. Analysis of Solid Waste	Environmental Chemists, Engineering Technicians
3. Collection & Transportation	Environmental Engineers, Engineering Technicians, Transportation Engineers, Refuse Collection Staff, Automechanics, Mechanical Engineering Technicians
4. Solid Waste Disposal	Environmental Engineers, Geologists, Hydrogeologists, Engineering Technicians, Heavy Duty Vehicle Operators, Automechanics, Site Superintendents

Visits by Water Sector Resource Persons

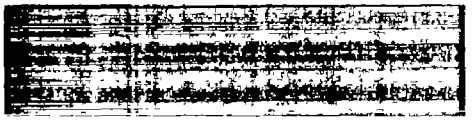
Teachers may invite reource persons from the water sector to come and talk to students on their own areas of specialisation or more generally on opportunities within the sector. Some suggestions are given below.

1. Invite a Waste Water Engineer/ Environmental Engineer to give a talk on:

- water pollution control.
- waste water treatment.
- technology, pollution and health.
- protection of water sources.
- re-use of waste water.
- manpower needs in waste water management.

2. Invite an Environmental Engineer/ Sanitary Engineer/Sanitation Officer to give a talk on:

- solid wastes: the need for proper disposal.
- solid wastes collection and disposal in the area of your school.
- landfills and compost plants for solid wastes management.
- manpower needs in solid wastes management.



TEACHER

How to Prepare, Organise and Follow Up a Study Visit

Before the Actual Visit

- Obtain permission from the school authorities to arrange and conduct the visit.
- Send a letter to the organisation/institution at least one month before the date on which you would like to visit. Give a number of possible dates.
- Follow up with a phone call. Establish contact with one or more contact persons. Find out how many students the organisation/institution can allow to visit.
- Collect background material about the organisation/institution to be visited. Open a file where you keep all material in connection with the visit.
- Brief students.
- Ask Students to prepare questions or questionnaires.
- Invite someone from the institution/organisation to come and give a career presentation before the visit. If possible, try to find a woman in order to give girls a role model.
- Since the visit will be exposing students to both processes and careers, it could be helpful to establish contact between career guidance teachers and science teachers. Maybe science teachers could help to prepare students for the visit eg. by conducting activities in their lessons which relate to the organisation to be visited.
- Arrange transport for the visit.

The Visit

- Teachers should take cameras, video cameras or tape recorders. Students should take note-pads and questionnaires.
- Take packed food if necessary.

After the Visit

- Ask students to write reports or give oral presentations. Present and discuss the best reports.
- Write about the school visit in the school magazine.
- Show video or photographs taken.
- Ask students to make posters.
- Discuss gender issues.
- Write a letter of thanks to the organisation/institution and include a good report.

Some Places to Visit

- Training Institutions
- Water Utilities, Water Affairs, Council Water Departments
- Village Water Supply
- Waste Water Treatment Plant and/or Sewage Ponds
- Landfill Sites and/or Dump Sites
- Private Companies dealing with drilling or groundwater exploration, or construction companies building water supply or waste water systems.

Worksheet

STUDENT

The Water Pump

Below you will see a diagram of a Rotary Mono Pump, which is the most commonly used pump in village water supply systems in Botswana.
Your assignment is to visit your local Department of Water Affairs Depot or Council Water and Waste Water Department and find out as much as you can about this pump and how it works.
After your visit you should be able to answer the questions below and provide labels for the different parts of the pump shown on the diagram.

Questions

1. How is the Rotary Mono Pump powered? (by batteries, electricity, diesel engine?)

_____

2. This pump has three main parts. What are these three parts?

_____

_____

_____

3. Label the different parts of the pump shown on the diagram. Try to find out the function of each of these parts.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

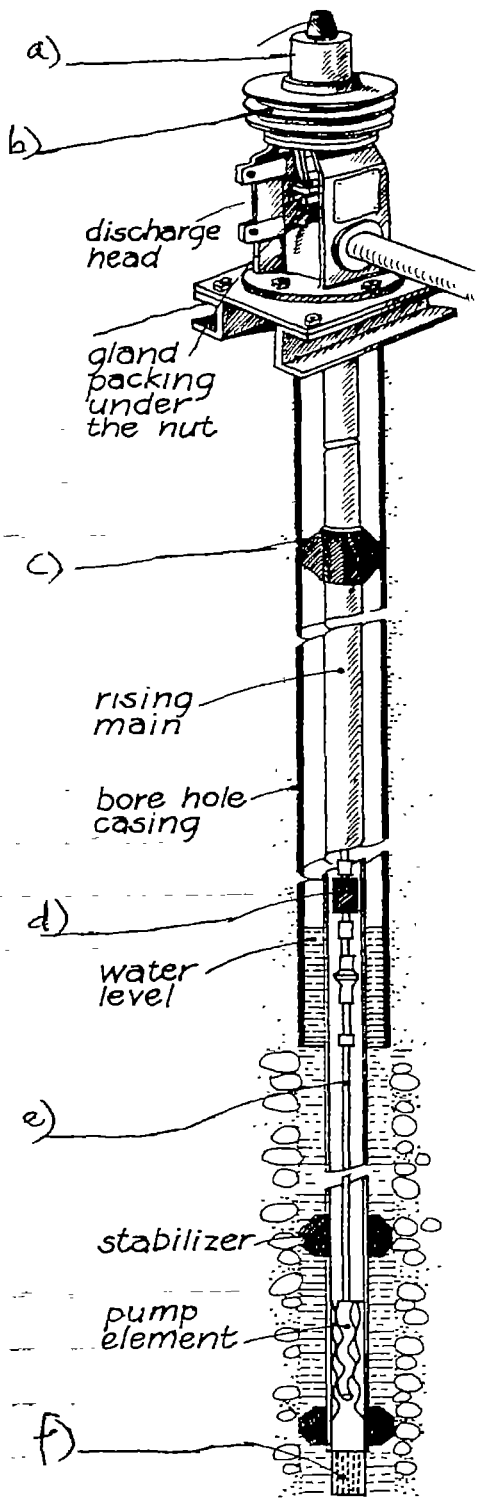
4. Give the job titles of those responsible for operating and maintaining a water pump for a village water supply facility.

_____

_____

_____

_____



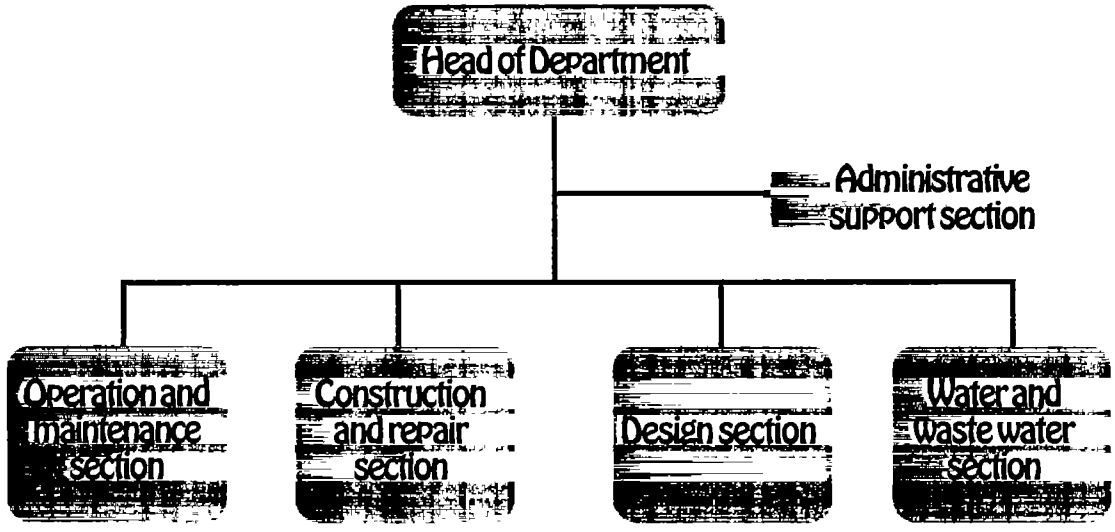
TEACHER

How Jobs are Organised

Organisational Chart

There are various ways to show how a company or department or any other organisation operates. The most common one is to draw an organisational chart or origram. The chart outlines how sections or units are related to each other, it shows who is in command and the line of communication within the organisation. A full chart would show each post of the establishment and its place in the organisation. An overview chart would show the different sections of the organisation.

Here is an overview chart of a District Council Water & Waste Water Department:



Schemes of Service

Each organisation has its own way of organising the various jobs and careers. In government organisations this is described in the schemes of service. The schemes of service will give information on:

- the main duties at each level of the organisation;
- what qualifications are needed to enter a certain career and what it takes to move from one level to another;
- the salary system that is used. For each post the basic pay is according to a certain scale and grade.

Each department has its own scheme of service, but there are great similarities.

Once a person has been employed in a certain organisation, he or she can be promoted and move upwards in a career. Promotion, however, never takes place automatically. It is normally based on the following:

- a person must have performed well in his or her present job, and must be recommended by the supervising officer and head of department;
- there must be a vacant post on the higher level;
- the person must have the formal qualifications and specific experience, including number of years in service on a certain level. That is why most schemes of service are often linked to certain training paths.

Below is an example of a scheme of service. The facts are taken from the scheme of service for the Department of Water Affairs. The scheme of service distinguishes between artisan, technician and professional levels.

■ Artisan Level

The posts to be found on this level are:
Technical Assistant

Senior Technical Assistant Grade II

Senior Technical Assistant Grade I

Principal Technical Assistant

Chief Technical Assistant.

The basic minimum requirement for entry to the lowest level, Technical Assistant, is a Trade Test B Certificate and five years experience within the trade. A National Craft Certificate is needed to become a Senior Technical Assistant Grade I. A person must work as Senior Technical Assistant grade I for at least 3 years before he or she can be considered for a promotion to Principal Technical Assistant.

■ Technician Level

The posts to be found on this level are:

Technical Officer

Senior Technical Officer

Principal Technical Officer

Chief Technical Officer

Superintendent

The basic minimum requirement for entry to this level is an Ordinary Technician Diploma, like the Water Engineering Technicians Diploma presented in **Work With Water**. A person must work as Technical Officer for at least three years with satisfactory service to be promoted to Senior Technical Officer. However, a person with a Higher National Diploma in, for example, Water & Environmental Engineering (see **Work With Water**, page 39) can be considered for direct entry to this level.

■ Professional Group II Level

The posts to be found within Department of Water Affairs in this cadre are limited to the chemistry profession. The posts are:

Assistant Chemist

Chemist II

Chemist I

Senior Chemist

Principal Chemist II

Principal Chemist I

An Assistant Chemist must have a Bachelor's degree in chemistry.

■ Professional Group I Level

There are four different professions belonging to this group:

Hydrogeologist,

Water Engineer,

Electro-mechanical Engineer,

Hydrologist.

These professions have in principle the same titles.

The posts to be found in the water engineering profession are:

Assistant Water Engineer

Water Engineer II

Water Engineer I

Senior Water Engineer

Principal Water Engineer II

Principal Water Engineer I

Chief Water Engineer

The basic minimum requirement for entry to the Assistant Water Engineer level is a Bachelor's degree in a relevant profession or field. To become a Water Engineer I you need to have a post graduate diploma or a master's degree.

TEACHER

■ Job Description

For each type of post listed in the schemes of service, there must be a specified job description. The schemes of service would only indicate the scope of work.

As an example, this is what the schemes of service for Department of Water Affairs says about the Technical Officer's (TO) scope of work:

A TO is a qualified technician able to accept full responsibility for the completion of a technical task in his/her area of expertise usually with only occasional advice and assistance from a more senior and experienced officer The TO is able to supervise and direct the work of technical assistants and industrial class employees to ensure expeditious and efficient completion of the task and the setting as well as achievement of high standards of workmanship. More specifically an officer in this grade will carry out the following duties:

- *The TO undertakes all tasks connected with construction works for water supplies including surveying, design and site supervision of construction, repair and maintenance of pipelines, storage reservoirs, pumping stations and renewable energy plants.*
- *The TO carries out field surveys, sets out work, collects and collates data for the detailed design of water supply and related projects, produces profiles and working drawings for the construction of such projects, keeps records and trains junior officers on the job*

The actual job description for a specific post would then add details and specifications of the overview given in the schemes of service. When a person is employed he or she should be given a copy of the job description for the particular post. The supervisor should also explain thoroughly what the description entails and what is requested of the employee.

Exercise:

When students are doing research, one of the tasks could be to find out whether the persons they interview have copies of their job descriptions. The students could ask for copies of job descriptions and bring them back to school for further analysis.

Other Activities and Topics for Discussion

STUDENT

Water

If you have a river near your school:

1. Go to the river or a reservoir and collect a sample of water in a bottle.
2. Go to where waste water is entering the river. Observe the condition of the river water - colour, smell, deposits, presence of fish, bubbles, spread of wastes etc.
3. Find out whether any one uses the downstream water for drinking/ bathing/ washing clothes etc.
4. Note how the water quality changes as you walk downstream.
5. Observe the quality of water in the river after a heavy rain. Is there any change? What is the difference?

At a Borehole:

1. Visit a nearby borehole. Observe a sample of water from the borehole.
2. Note the nearby surroundings. Are any of the following nearby: pit latrine, refuse heap, cattle manure, stagnant water pool? If any of these are near to the borehole, do you think that they could pollute the water underground.

Water Conservation

- Water is a scarce resource, especially in Botswana, a country which experiences unreliable rainfall and periodical drought. Look at the diagram on page 29 of **Work with Water.** Note how much water was used in 1990 and compare it with the amount that will be used in the year 2020.
- Read the section 'Protect the Environment' on pages 32-33 of **Work with Water**. The population of Botswana is growing rapidly. How will this affect the water supply?
- What do you understand by the term 'water conservation'?
- Visit a house in a town or city and examine how water is used and how it is wasted. Try to think of different ways in which water could be conserved in that house.
- Examine the ways in which water is used in your school and possible wastage of water. Suggest how water could be conserved in your school?
- Visit the Water Utilities Corporation and find out how much water is wasted in the water distribution system and why. Ask the engineer to explain the water conservation measures adopted by WUC.
- Use a bath-tub and measure the quantity of water you used. On another occasion, use a shower and again measure the quantity of water used. On which occasion did you use most water?
- Measure the quantity of water dripping from a leaking/not properly closed tap during a given period of time. Calculate how much water is wasted from the tap in one day.
- Visit a standpipe with a broken/leaking tap and think of ways to improve the situation.
- Find out how much water is used when flushing a toilet just once. Can you think of any way in which the quantity of water used could be reduced?
- Visit Gaborone Dam. Can you think of any ways in which the amount of water lost from the dam through evaporation could be reduced?
- Can you think of any measures which could encourage more people to conserve water used in their homes (eg. if additional charges were imposed on those who used very large quantities of water)?

Recycling

Make a *Water Uses Chain.* Students can do this individually or in teams.

a) Choose from one of the following categories:

1. water used in a persons home
2. water used at our school
3. water used in a given organisation such as a clinic, or restaurant, or hotel etc.
4. water used in our community
5. water used in Botswana

b) List all the ways in which water is used in the category that you have chosen (eg. at home: drinking, cooking, washing dishes, washing clothes etc.).

STUDENT

c) Can the water used for any of those purposes be re-used? List the number of ways in which water used in the category you have chosen could be re-used. Link together as many of the uses as possible to make a chain.
eg. dish-washing water can be used for watering plants - this chain has two links.

dish-washing ⟶ watering plants

eg. dish-washing water can be used for watering plants and then reused again as run-off to a compost pit - this chain has three links.

dish-washing ⟶ watering plants
⟶ run-off to a compost pit

The idea is to make the chain with the most links.

d) What do you think happens to the water at the end of your chain? Does it sink into the ground? Is that likely to cause any problems?

Waste Water

Disposal of Waste Water:

1. Visit a petrol station/garage/car repair shop. Ask or observe where waste water is discharged (ie. where it is thrown or where it flows to). Could it lead to groundwater pollution?

2. Visit a nearby farm/park/garden. Ask what chemicals are applied to the plants there (pesticides,fertilizers etc.). Do you think that these chemicals could contaminate groundwater?

3. Visit an industry such as a brewery, abattoir or tannery. Find out what happens to waste water at that industry.

4. Pay a visit to a city council or district council and talk to the engineer in charge of sewage. Find out what legislation or regulations exist which control the discharge of waste water into sewers or rivers.

5. Find out why protection of groundwater against pollution is more important than protection of surface water in Botswana.

Solid Waste Management

Storage and Collection of Waste:

1. Select a few houses and measure the quantity of solid waste produced.
2. Sort through the solid waste and find out how much of it is paper, plastic, metal, wood, waste food matter etc.
3. Examine the condition of the refuse bins at those houses. Look for the following: food waste sticking to the inside of the bins, flies around the bins, holes or corrosion of the bins, do the bins have lids that fit properly? etc.
4. Request the driver of a refuse-collection vehicle to show you how the compaction device works.
5. Check how much refuse one refuse-collection vehicle can carry.
6. Note how much time it takes to collect refuse from a given number of houses eg. ten.
7. Visit a supermarket or hotel or factory and see how the waste is stored.

Disposal of Waste:

1. Visit a disposal site, observe how the waste is laid, spread, compacted and covered.
2. Find out how a dead animal, such as a dog, is disposed of.
3. Find out what is done to properly dispose of a) a can of pesticides b) waste oil c) toxic industrial waste.
4. Which components of waste materials can be reused?
5. So you observe any of the following at the refuse disposal site: flies, mosquitos, rats, smoke, wind-blown papers or plastics, stagnant pools of water, people salvaging (ie people looking through the rubbish to see what they can use)?
6. Do you think that the refuse land-fill site can contribute to pollution of surface water or groundwater?
7. Find out how many vehicle-loads of refuse are deposited at the site daily. You could ask at the entrance.
8. Find out the names of the special types of machinery/vehicles which work at the site.
9. Find out what happens to the waste matter which remains covered at the site for a long time. Can it cause any problems at a later time?

Fun Activities

1. Select 10 words from the glossary at the end of **Work with Water**. Give the definitions of those words to the students and ask them to say which words are being defined. Give Students five minutes, then see how many correct answers they have.

2. Get students to make crosswords using some of the words given in the glossary. Students could also make crosswords using some of the abbreviations used in **Work with Water** such as WUC, DWA, WET and DLGSM.

3. Ask students to make their own glossaries of unfamiliar words. These may be words used in **Work with Water**, or may be words which students come across during their study visits or when conducting their own research.

4. Give students a long word or phrase which has something to do with water eg. water resources. Give them three minutes to make as many other words as possible out of the word/s you have given them. Points can be awarded as follows: two-letter words get two points, three-letter words get three points, and so on.

5. Ask students to write poems which convey the importance of water, or which contain messages about either environmental or gender issues.

6. Ask students to design a poster, draw cartoons, or devise car stickers which carry messages about the importance of water or of caring for the environment.

7. Get students to discuss what they consider to be waste. Get them to list the things which they call waste and give their reasons for calling those things waste. Get them to classify waste materials into the following categories: solid or liquid, organic or inorganic. Things like vegetable matter, bones and food waste are organic, while plastic and metal are inorganic. Organic waste decomposes easily, while inorganic waste does not.

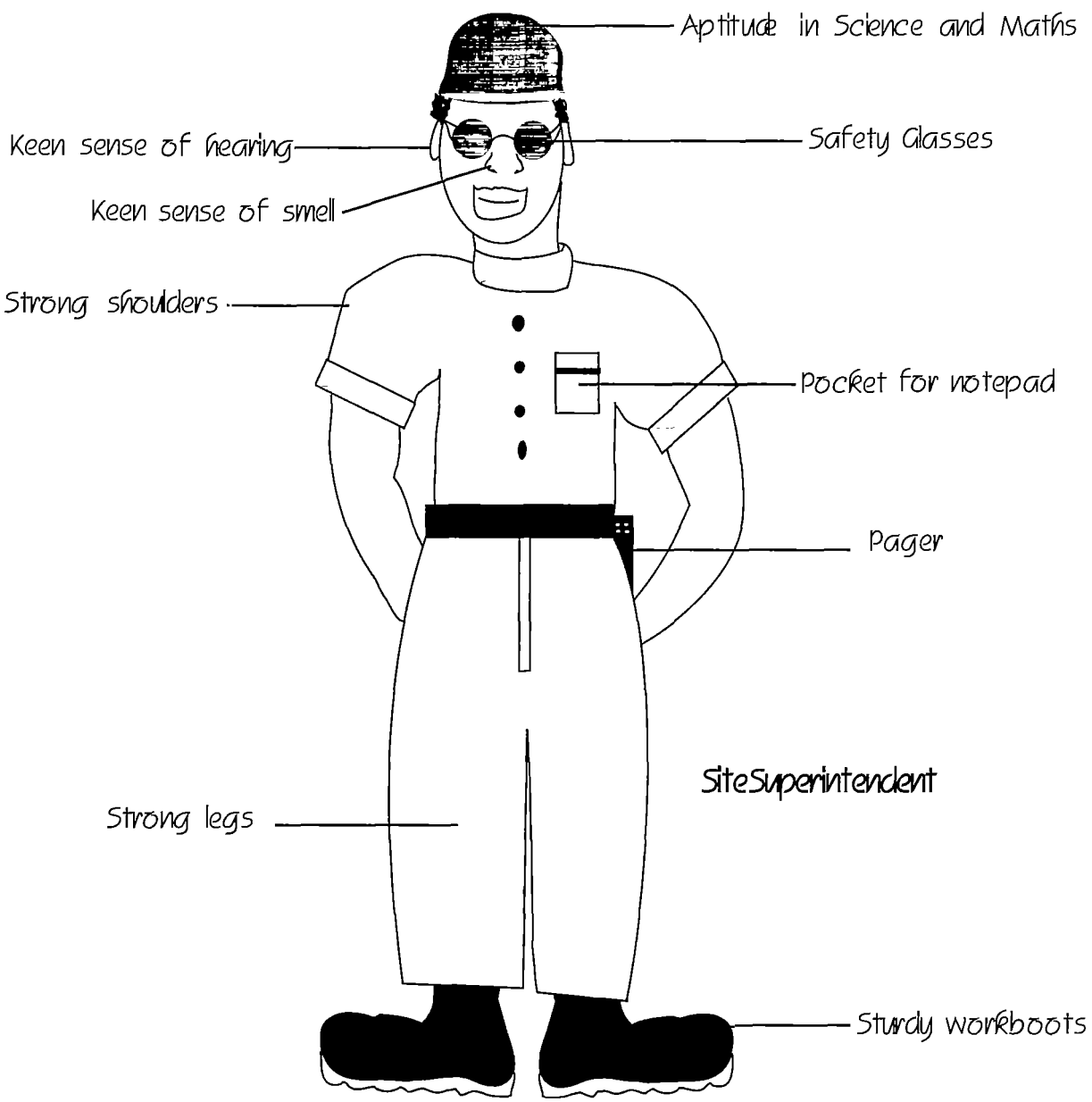
8. Ask students to collect rubbish from the school grounds. Get them to group the different types of rubbish into the categories given above.

STUDENT

9. Ask students to produce maps of the school grounds showing places where littering occurs, if any. They should indicate on their maps the following:

- the different types of rubbish/solid waste found in different parts of the school eg. food waste in the vicinity of the kitchen or dining hall.
- where additional rubbish bins should be placed in order to reduce the littering.
- whether any of the rubbish/solid waste could be recycled.

10. Ask students to prepare identikit drawings similar to the one provided below. Each student should then decide who his or her identikit drawing represents eg. a water engineer, a pipe fitter, a water laboratory technician etc. The students should label different parts of the identikit to show the different qualities or attributes which are required for the career which their identikit person occupies. They should think of physical qualities such as physical strength, good eyesight, strong legs etc., academic qualities, and personal characteristics such as commitment, patience, a good sense of humour etc.



Other Material to Use or Refer to

STUDENT

Videos

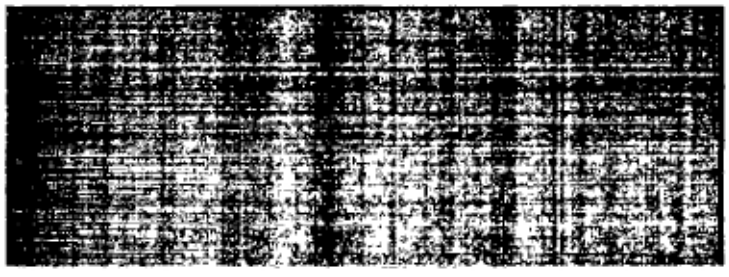
1. ***Science and Technology for the Future***, Guidance and Counselling Division, Ministry of Education, Botswana.
2. ***Opportunities for Health Sciences***, Guidance and Counselling Division, Ministry of Education, Botswana.
3. ***Role Models for Science-based Careers***, Guidance and Counselling Division, Ministry of Education, Botswana.

Books

1. Borchard, David, et al., ***Your Career Choices - Chance Changes***, (1980), Kendall/ Hunt Publishing Company.
2. Linhard, Niels, et al., ***Life Skills in the Classroom***, (1990), Maskew Miller Longman.
3. Linhard, Niels, ***Guidance in the Classroom***, (1985), Maskew Miller Longman.
4. Page, Anne, ***Your First Job***, (1984), Billing & Sons.

Other Materials

1. ***Botswana National Conservation Strategy***, Government Paper No. 1 of 1990
2. ***Handbook for Village Water Supply Operators***, Unified Local Government Service, 1990.
3. ***Girls-Boys: Roles and Careers***, booklet produced by the Gender and Education Committee, University of Botswana & Ministry of Education (undated).
4. ***Girls and Women in Science: Science Technology Roadshow Report & Manual***, Commonwealth Secretariat Education Programme, Ministry of Education, 1991.
5. ***Women and Men in Botswana: Facts and Figures***, booklet produced by Central Statistics Office and SIDA, 1991.
6. ***Career Manual for Botswana Schools***, Guidance and Counselling Division, Ministry of Education, Botswana, 1993.
7. ***A Handbook of Occupations for Junior Secondary Schools***, Guidance and Counselling Division, Ministry of Education, Botswana, 1993.



USEFUL ADDRESSES

Addresses

Here is a list of useful addresses and telephone numbers to organisations related to the water, waste water and waste management sector.

Local Government

The coordinating personnel department for all district, town and city councils is Department of Local Government Service Management. The department has specialised divisions for recruitment and training of staff for the councils. The address is:

Establishment Secretary
Department of Local Government Service Management
Private Bag 0052
Gaborone
Tel. 354 100
Fax. 304 613

Water & waste water services in the district councils are handled by the District Council Water & Waste Water Department. Waste water services in the town and city councils are handled by the sewerage section of the Engineering Department. Solid wastes services in all councils, both district and towns councils, are handled by the Public Health or the Environmental Health Departments.

All official letters to a council should be addressed to the chief executive of that council. The chief executive for a district council is the Council Secretary, for a town council it is the Town Clerk, and for a city council it is the City Clerk.

Please note that almost all district councils have sub-districts. Even in the sub-districts you will be able to find water & waste water units and public health units. The chief executive for a sub-district is the Assistant Council Secretary

Write on the envelope and the letter for the attention of the Head of Department you want to contact. Here is an example:

Council Secretary
Attention: Head of Water & Waste Water Department
North East District Council
Private Bag 4
Masunga

Here are the addresses and telephone numbers to all the councils.

Gaborone City Council
Private Bag 0089
Gaborone
Tel. 353521, Fax. 300141

Francistown Town Council
Private Bag 40
Francistown
Tel. 211050, Fax. 212 427

Jwaneng Town Council
Private Bag 01
Jwaneng
Tel. 380 303, Fax. 381 395

Lobatse Town Council
Private Bag 28
Lobatse
Tel. 330 392, Fax. 332 458

Selebi Phikwe Town Council
Private Bag 01
Selebi Phikwe
Tel. 810 570, Fax 814 854

Sowa Township Authority
Private Bag SOW1
Sowa
Tel. 613548, Fax 613425

Ghanzi District Council
Private Bag 15
Ghanzi
Tel. 596 211, Fax 596 213

Charles Hill Sub District
P.O. Box 47
Charles Hill

Southern District Council
Private Bag 2
Kanye
Tel. 340 217, fax. 340 103

Good Hope Sub District
P.O. Box 6
Good Hope
Tel. 386 229

North East District Council
Private Bag 4
Masunga
Tel 289 292, 289 263

North West District Council
Private Bag 01
Maun
Tel. 660 241, Fax 660 029

Gumare Sub District
P O. Box 60
Gumare

Chobe Sub District
P.O. Box 20
Kasane
Tel. 650 381, Fax 650 368

Kgatleng District Council
Private Bag 11
Mochudi
Tel. 377 411, Fax 377 216

Kweneng District Council
Private Bag 5
Molepolole
Tel. 320 200, Fax. 320 209

Letkhakeng Sub District
P.O. Box 86
Letlhakeng
Tel. 329 211

South East District Council
Private Bag 2
Ramotswa
Tel. 390 251, Fax. 390 201

Central District Council
Private Bag 01
Serowe
Tel. 430 411, fax. 431 360

Tutume Sub District
P.O Box 47
Tutume
Tel. 287 210

Bobirwa Sub District
P.O. Box 334
Bobonong
Tel. 819 276

Mahalapye Sub District
Private Bag 2
Mahalapye
Tel. 410 459

Serowe/Palapye Sub District
Private Bag 20
Serowe
Tel. 421 100

Boteti Sub District
Private Bag 5
Letlhakane
Tel. 278 219

Kgalagadi District Council
Private Bag 5
Tshabong
Tel. 540 250

Hukuntsi Sub District
P.O. Box 2
Hukuntsi

Addresses to Water Utilities Corporation

WUC Head Office
Private Bag 00276
Gaborone
Tel. 352 521, Fax. 373 852

WUC
P.O. Box 843
Francistown
Tel. 216 100, Fax. 213 326

WUC
P.O. Box 626
Tlwaneng
Tel. 380 397, Fax. 380 696

WUC
P.O. Box 230
Lobatse
Tel. 330 494, Fax. 332 468

WUC
P.O. Box 141
Selebi Phikwe
Tel. 810 270, Fax. 810 130

WUC
P.O. Box 47
Shashe
Tel. 213 878

WUC
Private Bag 55
Tlowa
Tel. 613 295, Fax. 613 295

Addresses to Department of Water Affairs

TEACHER

Director of
Department of Water Affairs
Attention Head of Training
Section
Private Bag 0029
Gaborone
Tel. 352 241, Fax. 374 372

DWA
Private Bag F181
Francistown
Tel. 212 368, Fax 213 449

DWA
P.O. Box 37
Ghanzi
Tel. 596 226

DWA
P.O. Box 291
Kanye
Tel. 340 381

DWA
P.O. Box 26
Kasane
Tel. 650 323

DWA
P.O. Box 8
Letlhakane
Tel 278 267

DWA
P.O. Box 42
Lobatse
Tel 330 204

DWA
P.O. Box 30
Mahalapye
Tel. 410 251

DWA
Private Bag 002
Maun
Tel. 660 452

DWA
P.O. Box 486
Mochudi
Tel. 377 330

TEACHER

DWA
P.O. Box 193
Molepolole
Tel. 320 263

DWA
Private Bag 007
Moshupa
Tel. 349 228

DWA
P O. Box 21
Palapye
Tel. 420 286

DWA
P.O. Box 89
Ramotswa
Tel. 390 225

DWA
P.O. Box 203
Serowe
Tel 430 441

DWA
P.O. Box 132
Thamaga
Tel. 399 219

DWA
P.O. Box 86
Tonota
Tel. 284 231

DWA
P.O. Box 7
Tshabong
Tel. 540 216

Addresses to Other Departments and Organizations

Department of Geological Surveys
Private Bag 14
Lobatse
Tel. 330 327, Fax. 332 013

Environment Watch Botswana
Somarelang Tikologo
Private Bag Bo136
Gaborone
Tel 301 961

Kalahari Conservation Society
P.O. Box 859
Gaborone
Tel. 314 259, 306 192

Tshomarelo Okavango Conservation Trust
Private Bag 13
Maun
Tel. 660 852

Botswana Society
P.O. Box 71
Gaborone
Tel 351 500

Botswana Technology Centre
Private bag 0082
Gaborone
Tel. 314 161, Fax. 374 677

Rural Industries Innovation Centre
Private Bag 11
Kanye
Tel. 340 392, Fax. 340 642

IUCN
Private Bag 00300
Gaborone
Tel/Fax. 371 584

Addresses for Training Institutions

Ministry of Education
Department of Student Placement & Welfare
(Old Bursaries Dpt.)
Private Bag 005
Gaborone
Tel. 312 706, Fax. 312 891

University of Botswana
Private Bag 0022
Gaborone
Tel. 251 151 Fax. 356 591

Botswana Polytechnic
Private Bag 0061
Gaborone
Tel. 352 305 Fax. 352 309

Institute of Health Sciences
P.O. Box 985
Gaborone
Tel. 353 033 Fax 300 935

Madirelo Training & Testing Centre
P O. Box 10087
Gaborone
Tel. 356 318

Vocational Training Centres

Jwaneng VTC
Private Bag 009
Jwaneng
Tel. 380 685 Fax. 380 890

Gaborone VTC
Private Bag 00358
Gaborone
Tel/Fax 304 817

Auto Trades Training Centre
Private Bag 00170
Gaborone
Tel. 353 961 Fax. 313 083

Palapye VTC
Private Bag 0046
Palappye
Tel. 420 576 Fax. 420 960

Maun VTC
Private Bag 0073
Maun
Tel/Fax. 660 518

Selebi-Phikwe VTC
Private Bag 0062
Selebi-Phikwe
TelFax. 810 045

Brigades

Bobonong Brigade Centre
P.O. Box 525
Bobonong
Tel. 819 237

Tshwaragano Brigade Centre
P O. Box 181
Gabane
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Ghanzi Brigades
Development Trust
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Ghanzi
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Ngethu Brigades
Development Trust
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Gweta Brigades
Development Trust
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Kang Brigades Development Trust
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Kanye Brigades
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Tel. 340 255 Fax. 340 534

Ramatea Vocational School
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P.O. Box 42
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Matsheng Brigades
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Boteti Brigade Centre
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Tsweleopele Brigade Centre
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