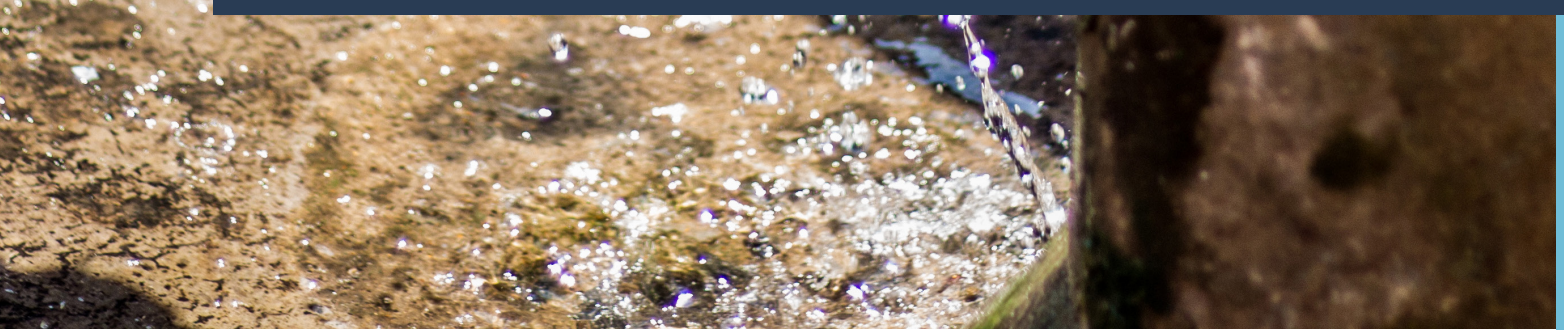
GLSCRP
GIYANI LOCAL SCALE CLIMATE RESILIENCE PROGRAMME

WATER RESEARCH COMMISSION

LEARN HOW TO OPERATE A BOREHOLE PUMP

A BOREHOLE PUMP OPERATOR'S HANDBOOK



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GIYANI LOCAL SCALE CLIMATE RESILIENCE PROGRAMME

The Giyani Local Scale Climate Resilience Programme (GLSCRP) aims to develop and implement activities that will research, develop and demonstrate climate adaptive responses and solutions for optimising water utilisation in drought-stricken areas.

The programme will focus on the Greater Giyani Municipal area within the Mopani district and aims to impact an estimated 5000 beneficiaries over a three-year period in terms of water utilisation, improved water mix, and socio-economic opportunities as responses to climate adaptation.

A 2019 WRC study on droughts and adaptation strategies has highlighted risks to reduced productivity, livelihoods and food security, and an increase in vector and water-borne diseases in communities such as Giyani. Ultimately, climate change impacts on water resources in the Giyani area cannot be underestimated.

The programme has three key areas that will support for improving local scale adaptation and resilience in Giyani.

They are:

1) a strengthened enabling environment whereby local authorities, institutions, communities, traditional authorities and market players are mobilised to improve climate resilience and water utilisation;

2) improved energy, ground and surface water solutions developed with communities to optimise and diversify water sources;

3) activities that support livelihoods and local economic development opportunities.

The programme will cover a spectrum of rural and rural residential areas in Giyani, working closely with the Mopani District Municipality and the Greater Giyani Local Municipality. Implementation partners include Tsogang Water and Sanitation as the lead on water projects and infrastructure; Association for Water and Rural Development (AWARD) in support of capacity development and stakeholder engagement, University of the Western Cape (UWC) as the water and energy technical partner and the WRC's TTO Enterprise Development arm on social enterprise development supporting local economic development projects.

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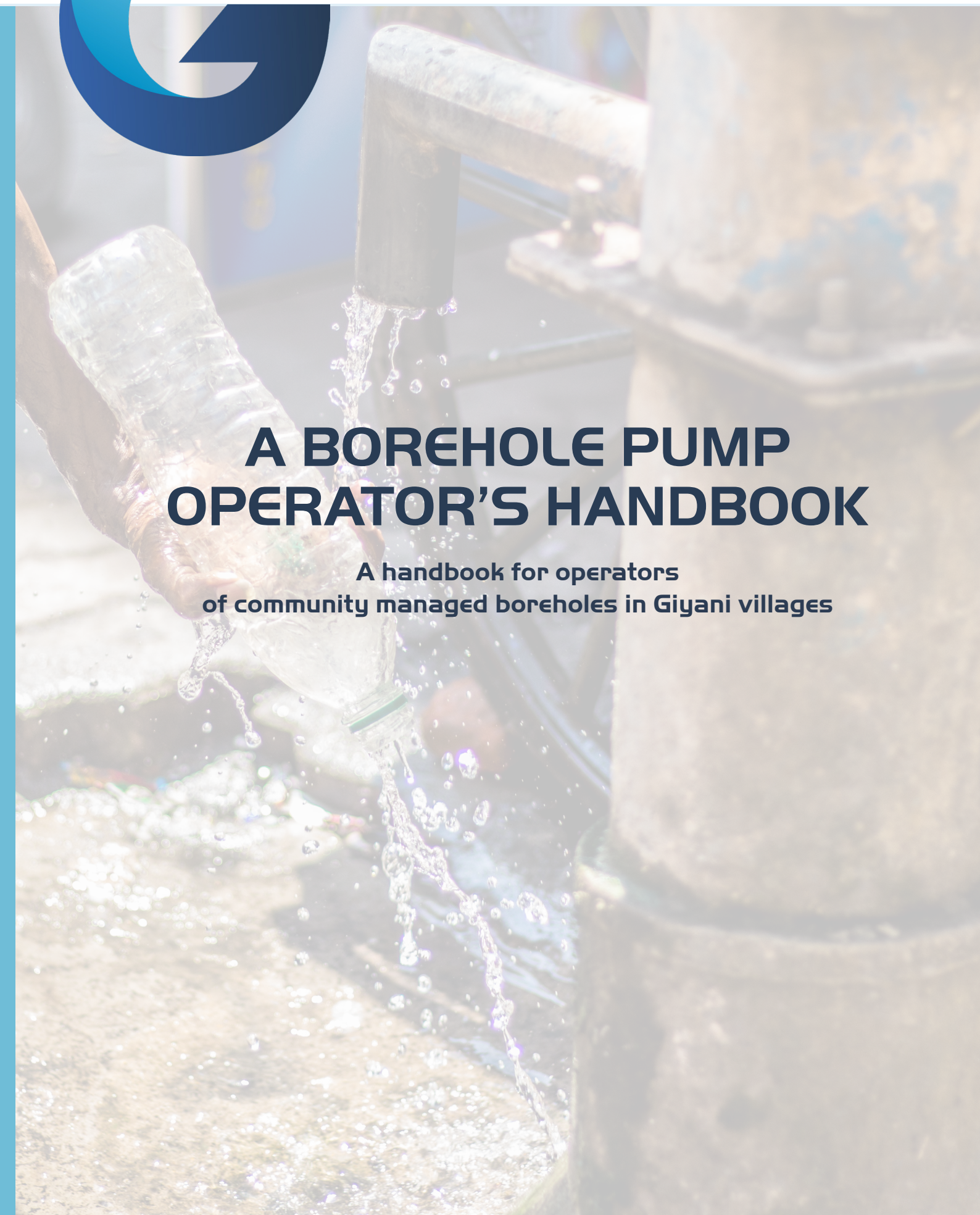


A BOREHOLE PUMP OPERATOR'S HANDBOOK

A handbook for operators of community managed boreholes in Giyani villages

ABOUT THIS HANDBOOK

Operating a borehole is not a simple as it may seem. It is not simply about switching on the power or starting the generator then waiting for water to reach our homes.

There is a lot of planning, preparation and management that is required. When it comes to operating a borehole that is shared by a number of homesteads in a village, the operation of the borehole becomes a social issue. This means that there is co-ordination required, sharing of responsibilities, taking care of maintenance, ensuring there is adequate security and that the use of the water is well managed. Without these things the water supply will collapse and homes will be without water.

Illustration / Image / Source

Who is the handbook for?

This handbook is meant for borehole operators or any person responsible for operating a community borehole pump.

What does the handbook contain?

In this handbook we share important information on the operation of community operated boreholes. We share important maintenance information, guide the borehole operators with daily duties, explain how and why certain tasks are essential.

The handbook is divided into TASKS and each task is broken down into the What? Why? When? Who? And How? This means that the operator can understand the details of each task fully. At the end of each task we provide recommendations for the operator on how to complete the tasks more successfully or provide alternative methods, if there are any.

"Community borehole operation is a social issue"

How to use the handbook?

This handbook should be used along with the training that will be given by the project team. After that the Handbook should be kept by the Pump Operator or stored along with the pump in the pump house, if it is secure.

TASK 1

COLLECTING INFORMATION ABOUT YOUR BOREHOLE

Before you can start to manage your borehole, you need to know more about it. Where it is, how deep it is, how old it is, how much water it can pump in both the dry and wet seasons, how powerful the pump is, how many hours it can safely be pumped for and so on... these are all essential for the pump operator not to damage or deplete the groundwater. In order to make sure that you do not expose your borehole to any risks you need to have some basic information about it.

Because not all boreholes are the same!

WHY?

Why do you need basic information about your borehole?

Having a record of your borehole information allows us to make sure that the borehole is not over-used or damaged through incorrect usage. Also, if maintenance is required we are able to move quickly to order parts and know what kind of borehole pump we are dealing with. Because borehole repair is costly and time consuming the more information we have the quicker and cheaper the repair process will be.

"A non-functional borehole is of no use to anyone"

WHO?

Who collects the basic borehole information?

Collecting basic borehole information is usually a once-off exercise that is done when the borehole and pump are installed. But it might be necessary to update the basic information iif the borehole is repaired, a new pump installed and changes made. It is conducted by the pump operator supervisor (Technical staff of the Water Service Provider or District Municipality .

(The borehole drilling company will often provide the basic information)

WHAT?

1.Record the exact position of the borehole
There is a number of ways to do this, some are more accurate than others. However we do it, it is important to give an exact location of your borehole because many villages have more than one borehole. Without knowing exactly where boreholes are makes it difficult for a maintenance team to locate them when there is a need.The exact location is recorded by taking co-ordinates with a GPS or a smart phone

2.Record the amount (yield) of water that comes from your borehole
This can be done with a stopwatch by measuring the time required to fill a container of known volume, for example a 2 L plastic bottle, a 5 L bucket, a 10 L canister or similar. It is essential to know how much water your borehole can provide. If you pump more than it can provide there is a danger of damming the pump and also the supply of water underground. This is one of the most important pieces of information that you need as a borehole operator so that you do not OVER PUMP your borehole.

3.Keep a record of the drilling process and installation
This is called a drilling log and contains all the information that the drilling company provides when they install the borehole. In the drilling log is usually the water strike depth (the depth underground at which the water is found) and yield (litres that can be pumped per second and for how long), static water level, water quality, pumping tests and hydraulic properties. See the section on How? below for more details.

The log will also contain all the technical information about the drilling process, nature of the rocks and soils underground, materials installed and so on. If there is a problem with the borehole, another drilling company will request the drilling log to make sure that they can repair it properly.

HOW?

How is the basic borehole information collected?

The information on the borehole is usually collected according to set categories and criteria.

These are:

Installation date and type
Drillers details
Borehole depth
Diameter of hole
Casing and screen details
Riser main material and diameter
Depth to pump (m)
Type of power supply
Type of pump
Pump power (kW)
Serial number of the pump
Pump supplier detail
Electrical meter number (If applicable)
Dipper tube depth and nominal diameter (If applicable)
Water meter make, type and number

Set up your own Basic Borehole Information sheet in your workbook using the categories above.

RECOMMENDATIONS

1.Record keeping is essential, without it the borehole cannot be managed!
2. The pump operator and water committee should have a record of the basic borehole information.
3. A copy of all information should be stored in the offices of the Water Services Authority (District Municipality)

BASIC INFORMATION SHEET

Summary of production boreholes in the area (DWAF, 2004)

Village name	Population	Borehole no.	Coordinates		Property unit	Property size (ha)	Quaternary catchment	General authorization limits (m^3/a)	WARMS no.	Registered (yes/no)	Licensed (yes/no)
			Latitude	Longitude							

TASK 2

WORKMANSHIP QUALITY CHECKLIST

It is an unfortunate reality that that all installations meet the necessary standards, leaving communities with poorly functioning boreholes (borehole collapsing, drying out or pump breakdowns) shortly after installation. It is therefore the responsibility of water committees to take ownership of the installation process and track the quality of workmanship for themselves. This checklist will help you to do that.

WHAT?

What is the Workmanship Quality checklist?

It is a checklist of items used to determine that standards are met and that a good job has been done in installing the borehole. The two purposes are:

- To verify the quality of workmanship for groundwater pumping installation.

- To help assess if the quality of installation adheres to best practices, safety requirements and overall installation sustainability

WHO?

Who uses the workmanship quality checklist to check on quality?

The pump operator: a person on the ground responsible for the day-to-day operation and maintenance of the system (e.g. a volunteer pump operator, a farmer or a community Water Committee member) The pump operator supervisor: a technical person that is responsible to supervise the pump operator and support monitoring activities (e.g. staff of the Water Service Provider or District Municipality)

WHY?

Why is it important to do a quality checklist?

It is important for a community to know that standards are met when they receive a new borehole. Without keeping a check on the installation process communities might be left with a borehole that does not function due to poor workmanship.

How do you complete a workmanship quality checklist?

A workmanship quality checklist consists of a number of questions in a table. The answer to each question is either Yes or No. There is also an option to show how further action is taken if the answer is No. (See Data Sheet XXX in your folder for this Checklist) The checklist on the next pageindicates the category of questions and the questions. Use the data sheet provided to record your responses and to track the quality of workmanship. Note that this checklist makes provision for systems that are solar powered.

MAINTENANCE CHECKLIST

Workmanship Quality Checklist

0. General	Did the manager receive written instructions on operation and maintenance of the system components?
0. General	Did the operator receive on-site training on operation, maintenance and potential troubleshooting of the system components?
0. General	Did the operator receive contact details for technicians and other technical support?
0. General	Component compliance: are all the component installed (type, brand, quality, size, etc.) exactly the same as what was designed/invoiced?
0. General	Has an acceptance and system test taken place after installation and do all the components, and the entire system, perform as designed?
0. General	Is the installation properly protected from theft, stray animals, vandalism etc.? / is the fence high, strong enough?
0. General	Have the solar panels been clearly and prominently marked (on the underside) with the owner's details or other unique identification?
0. General	Have the serial numbers of key components been recorded in order to clearly claim ownership in the event of theft?
1. Solar Generator	Quality of solar panel: are there cracks, brown spots, burn marks, other anomalies?
1. Solar Generator	Quality of panel cabling: are there any loose, unsealed or hanging cables? Any exposed copper wire visible? Any cables exposed to weather (sun/rain)?
1. Solar Generator	Are the solar panels securely mounted (no loose or missing bolts) on the mounting structure?
2. Mounting structure	Placement: have objects that might shadow the solar panels been removed? Is there a risk of shade and shadow in the future (e.g. small trees, bushes)?
2. Mounting structure	Placement: is there enough space between the panels and other components to allow proper maintenance?
2. Mounting structure	Are there signs of corrosion or rust on the metal frames? Note: metal frames should not touch the aluminium solar panel frames as this might increase risk of galvanic corrosion.
2. Mounting structure	Is the mounting structure stable and sturdy to withstand strong winds? Are there sufficient cross beams to avoid frame twisting?
2. Mounting structure	If the mounting structure is cast into a cement foundation, are there cracks in the foundation? Does the foundation appear strong enough when hitting it?
3. Controller/ Inverter	Is the controller protected against rain in a rainproof and dry casing? Is it protected from animals/insects and vandalism? - Check for signs of insects, tightness of cable-glands, locks.
3. Controller/ Inverter	Is the controller placed with sufficient ventilation around it? The controller must not over-heat.
3. Controller/ Inverter	Grounding/ earthing: Are the vital components of the solar generator protected against lightning? Are grounding cables insulated and installed?
4. Water pump	Is the pump installation properly protected from theft, stray animals, vandalism, flooding etc.?
4. Water pump	Was a well pump installed with a safety rope to allow for safe installation and extraction?
4. Water pump	Are the electric cable and water pipe (feeder pipe) exiting the well or borehole protected from chafing and bending or kinks?
5. Monitoring system	Are the measurement instruments protected from damage through exposure to weather, people and animals?
6. Reservoir	Are feeder pipes leading to and from the reservoir protected against physical damage and securely fastened? Are they protected against direct sunshine?
6. Reservoir	If the reservoir or tank stand is placed onto a concrete foundation, are there cracks in the foundation? Does the foundation appear strong enough?
6. Reservoir	If a tank stand is used, is it securely fixed onto the ground, with sufficient cross bars, to avoid toppling over?
6. Reservoir	Can the reservoir be easily maintained? - Check for drainage pipes, and easy access to clean the inside.
6. Reservoir	Is the reservoir closed at the top in order to avoid algae growth (which will clog piping) and reduce evaporation?
7. Piping and fittings	Can the distribution system be easily maintained? - Check for accessibility to individual components and means to bypass certain components.
7. Piping and fittings	Is the required equipment for maintenance available and easily accessible? - Check for storage of brushes, cloths etc.
7. Piping and fittings	Is it possible to easily replace individual components when they get broken? - Check if all the connections can be easily loosened, replaced and fastened.
7. Piping and fittings	On farms, are the drip laterals spaced according to the design and free of kinks and twists?
7. Piping and fittings	Are any of the components, connections and fittings leaking?
8. Chemica	Is there a proper facility for storage of the chemicals/fertilizers in line with health and safety precautions?

TASK 3

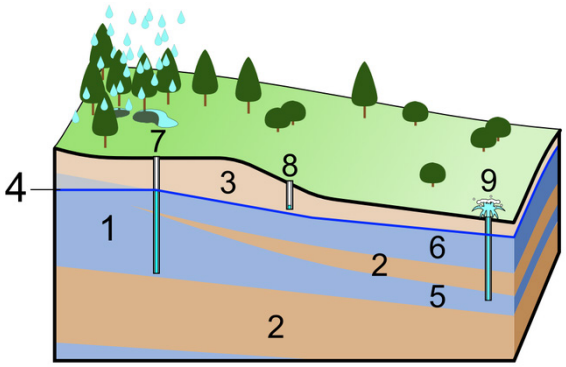
MEASURING GROUNDWATER ABSTRACTION

When we take something away from a particular place we call it extraction. In mathematics we call a similar process subtraction. When we remove water from below the earth's surface we call it abstraction. It is very important to know how much water we are removing from below the earth's surface because there is not an unlimited supply. If we remove too much water we call it unsustainable with the result that our boreholes dry up leaving us without water until the rains return.

WHAT?

What is groundwater abstraction?

Groundwater is the water present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. About 30 percent of all readily available freshwater in the world is groundwater. An aquifer is an area rock formation that carries water an that can yield a usable quantity of water. The depth at which soil pore spaces or fractures become completely filled with water is called the water table. (Wikipedia)



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WHO?

Who is responsible for measuring groundwater abstraction?

Groundwater abstraction volumes or rates should be recorded by the Pump Operator, a person on the ground responsible for the day-to-day operation and maintenance of the system (e.g. volunteer operator, a farmer or a community Water Committee member).

WHY?

Why do one need to measure groundwater abstraction?

The more we use groundwater the lower the water level or water table becomes. After switching the pump off, the groundwater level takes some time to recover to the original (static) level. If we do not keep a good record of how much water we are taking from the aquifer we can end up using more water than is being replaced resulting in our boreholes drying.

How do we measure groundwater abstraction?

Abstraction volumes are usually measured with water (Volume) meters in litres or m3 per day. This can also be calculated from the number of hours pumped per day if the pumping rate is known. Pumping rate can be measured manually with a container of known volume and a stop-watch. Details of these techniques will be demonstrated in the training sessions.

Illustration / Image / Source

How does one record the groundwater abstraction measurements?

Routine/regular measurements using a water meter need to be written down and stored as records so that we can compare the functioning of the borehole over time. Date, time and abstraction volume can be written down on specific sheets (logbooks) that need to be stored safely.
(see data sheet xxx)

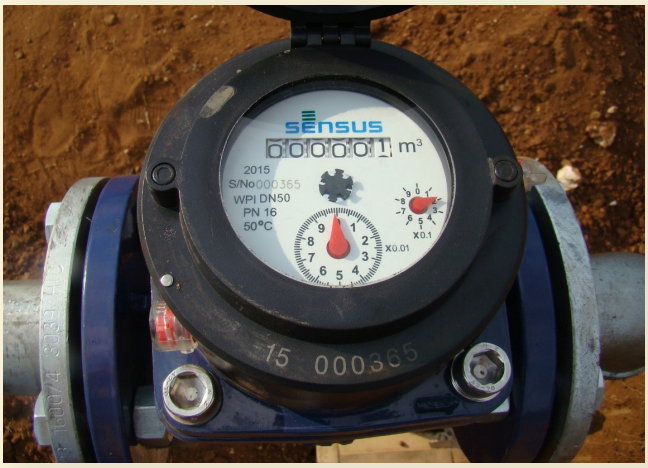
You will be given an opportunity to fill in a data sheet recording abstraction during the training session. The smaller clocks on the water meter show smaller amounts:

X 0.1 clock measures 100 litre intervals and a full revolution of the clock is 1 kilolitre.

X 0.01 clock measures 10 litre intervals and a full revolution of the clock equals 100 litres.

1 litre intervals can be read from the small ticks of the X 0.01 clock.

It is sufficient to record abstraction in m3 in the log-sheet.



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RECOMMENDATIONS

Water meters must be protected! They are sensitive and expensive.

Water meters can easily be clogged if the water flowing through them contains sand or other large particles. An in-line strainer can protect the water meter from clogging. Water meters and in-line strainers require regular checking and maintenance as part of the routine operations and maintenance. The pump operator should backwash the strainer or filter regularly. Besides a water mater, it is highly beneficial to have a pressure gauge installed in the pipeline to monitor whether water at sufficient pressure is delivered to the users. A pressure gauge should be installed by the supplier and readings recorded by the pump operator.

TASK 4

MONITORING GROUNDWATER LEVELS

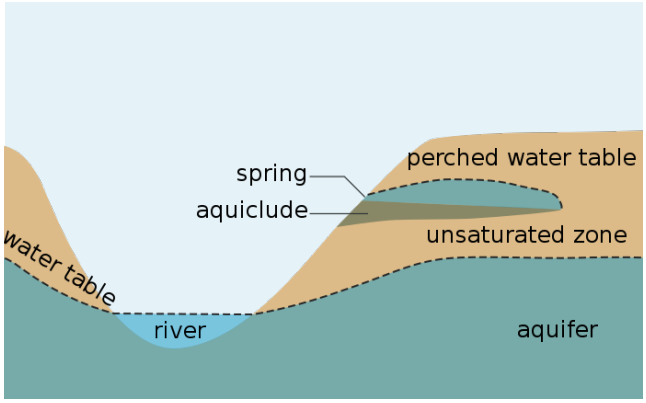
Groundwater is a highly useful resource and often commonly used in rural areas of Giyani. Most land areas on earth have some form of water underground in aquifers. The groundwater depth in aquifers varies from place to place, sometimes significantly. In some cases, groundwater in aquifers is rapidly being depleted by the human population. When we overuse our boreholes they become dry until they can be recharged by rainfall.

WHAT?

What is the groundwater level or water table?

We will deal with groundwater levels and how we measure them in this task (see figure xxx). The water table is the upper surface of the zone where the soil spaces contains water (called the zone of saturation). It is the level/depth at which we strike water when we dig a borehole or well. In simple terms it is explained as the depth below which the ground is saturated with water.

The water table may vary due to seasonal changes and is especially dependant on rainfall. Springs, rivers and lakes occur when the water table reaches the surface and groundwater feeds them. When the groundwater table drops, rivers and lakes feed groundwater and we might find that they dry up.



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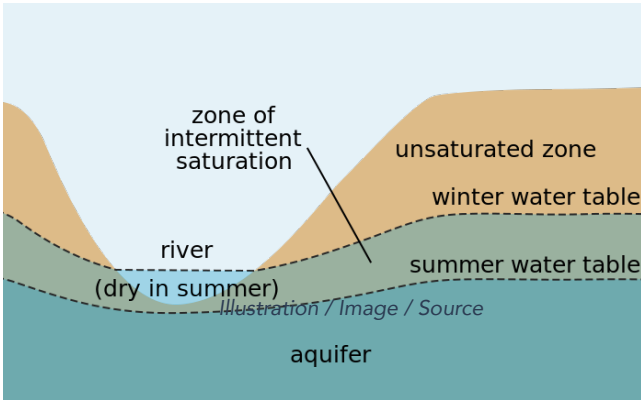

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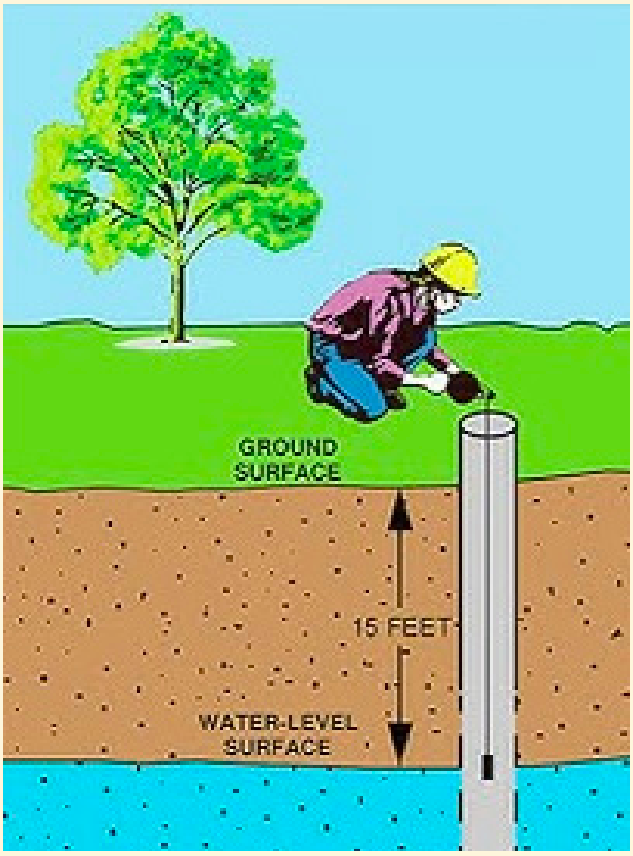
WHY?

Why do we monitor groundwater levels?

When we over use our boreholes there is a risk to our water supply. Over-use, over-abstraction or overdraft, as it is called, can cause major problems for village water security. The most important issue for people is a lowering of the water table beyond the reach of existing wells. This means that we need deeper boreholes or we need to wait for rain.The groundwater depth should be measured regularly to establish whether the aquifer is being over-pumped and to establish an efficient pumping rate for individual boreholes. This is one of the most important tasks of a borehole operator and essential for managing groundwater supply.



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WHO?

Who should measure groundwater levels?

Groundwater depth monitoring is done by the Pump Operator. This is a responsible duty and not everyone should be allowed to access the borehole without permission.

How does one measure groundwater levels?

The measurement of groundwater depth is taken with a Dip Meter consisting of a tape measure that releases a light or noise when it is lowered in the borehole to the water table. Groundwater depth is measured on rest water levels, after allowing the groundwater table to recover after pumping. rest water levels, after allowing the groundwater table to recover after pumping.

How often do you measure groundwater levels?

It must be measured on a routine basis, but before switching the pump on, and after the pump has rested for some hours. The measurement must be recorded in a datasheet and stored for comparison. Information that is not written down is not useful for future use.

Date, time and groundwater depth measurements should be written down on specific sheets (logbooks) that need to be stored safely. This information is useful for professional hydrogeologists to assist you with sustainable aquifer use in your village. The Pump Operator needs to follow these steps when measuring groundwater levels:

The pump operator needs to record the following measurements:

Date, Time and Groundwater depth measurement..

See the data sheet for entering measurements for long-term records.

GROUNDWATER LEVEL DATA SHEET

Village:				Borehole number:			Operator name:	
Date	Before pumping			After pumping			Total hours pumped (hh:mm)	Volume pumped (m^3)
	Flow meter reading (m^3)	Time of start of pumping (hh:mm)	Ground water depth (m)	Flow meter reading (m^3)	Time at end of pumping (hh:mm)	Ground water depth (m)		

RECOMMENDATIONS

Monitoring of groundwater levels with data loggers is becoming more and more common. These are pieces of electronic equipment that can be programmed to record readings at set intervals without manually having to be present.

The information can be retrieved from the data logger when it is convenient. Such monitoring provides data of groundwater levels at a pre-programmed frequency (usually 30 min or 1 h). This allows to monitor groundwater abstraction, recovery and recharge events – information that is important for understanding the aquifer system.

Loggers cost around R5 000, however a laptop for downloading data with the processing software installed is also essential. Loggers are usually installed in key monitoring boreholes only. Although costly the use of dataloggers should be planned as a network activity between villages so that costs can be kept to a minimum.

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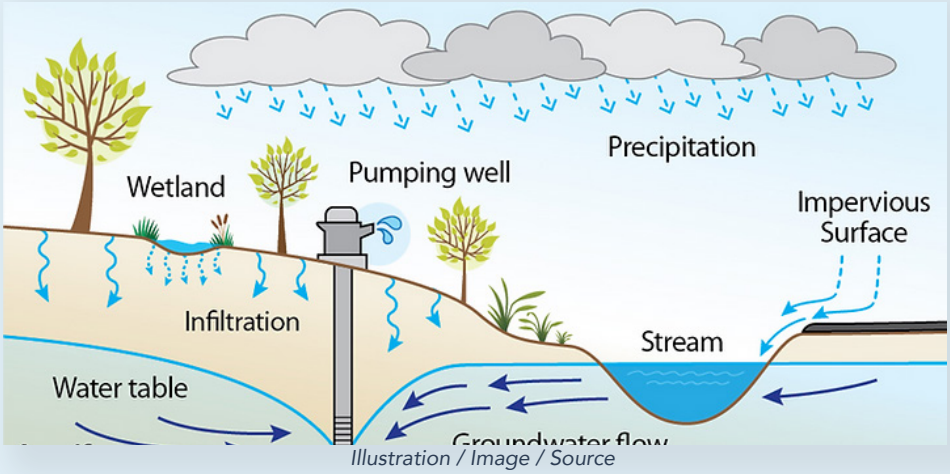
TASK 5

MEASUREMENT OF RAINFALL



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WHAT?

What is the purpose of measuring rainfall for borehole management?

Most of the water underground water comes from rainfall. As we use groundwater it gets replenished by rainfall. We call this process groundwater recharge (see figure xxx) With low rainfall there is almost no groundwater recharge. Recharge occurs only occasionally during events of heavy or persistent rainfall.

By measuring the rainfall we can get an idea of how quickly the groundwater in our area is being recharge. This is important for use to know so that we can regulate our use of groundwater.

WHY?

Why is it important to keep long-term records of rainfall?

Since the process of groundwater recharge is slow, we need to keep a long term record of rainfall so that we can understand how the recharge process may be occurring. Historic records in rural areas are scare which means that there is an increased risk of over use or depletion of groundwater.

Rainfall is measured because it is closely related to groundwater levels and recharge in the case of most aquifers and are fundamental because historic records are scarce in rural areas.

WHO?

Who is responsible for measuring rainfall?

Rainfall should be recorded by the Pump Operator or a person who has been instructed on how to do it accurately. Inaccurate rainfall data is useless as it will give us the wrong picture of what is happening to the borehole with groundwater recharge.

How do we measure rainfall?

Rainfall measurement is a simple process BUT it must be done correctly and accurately for the information to be useful.Rainfall should be measured near every production borehole or for a group of boreholes in the same area.

Measurement can be done with a manual Rain Gauge and rainfall must be read off after each rainfall event. One should use the Log-Sheet Template to capture the rainfall measurements. Date and rainfall amount in mm should be written down on specific sheets (log-sheets) that need to be stored safely

You will need to take the following steps for using manual rain gauges and also recording the results:

After each rainfall event or at a determined time of day (usually early morning) the measurement should be taken.

Remove the gauge form the stand/support.
Hold the rain gauge at eye level.

Take a reading of the amount of water in the gauge by looking at the markings on the gauge. These readings are in mm.

Record the reading on the data sheet provided
Empty the rain gauge and return it to the support.

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RECOMMENDATIONS

1. Ensure that the rain gauge is kept away form buildings and trees, in an open area not far from your boreholes .
2.The rain gauge should be supported on a pole that is approximately 1m in above the ground. The top (base of the cone) should be kept as flat as possible
3.Always make sure the rain gauge is empty after taking a reading.
4 Remove any dust and dirt from the cover.

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GIYANI LOCAL SCALE CLIMATE RESILIENCE PROGRAMME

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