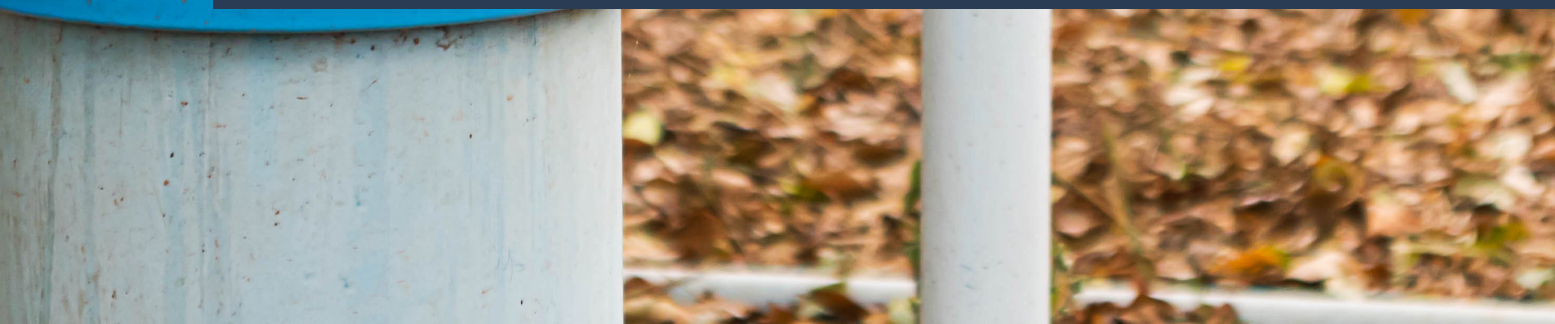




LEARN HOW TO OPERATE A SOLAR PUMP

A SOLAR POWERED PUMP OPERATOR'S HANDBOOK



Acknowledgements

We gratefully acknowledge the funding and support for the programme entitled Adaptive Response and Local Scale Adaptation for improving water security and increasing resilience to climate change in selected communities in Giyani, Limpopo. The programme is funded by the Government of Flanders, managed by the Water Research Commission and implemented by Tsogang Water and Sanitation, Association for Water and Rural Development (AWARD), University of the Western Cape (UWC) and the WRC's TTO Enterprise Development.



Disclaimer

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The Giyani Local Scale Climate Resilience Programme (GLSCR) 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 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.



The background of the cover is a photograph of a solar-powered pump. It shows a blue cylindrical base with a white vertical pipe. A metal elbow pipe with a rope coiled around it is attached to the top. The background is a bright, hazy outdoor scene with trees and a clear sky.

A SOLAR POWERED PUMP OPERATOR'S HANDBOOK

**A handbook for operators of community managed solar driven
pumps in Giyani villages.**

ABOUT THIS HANDBOOK

Operating a borehole that is linked to a solar driven system requires special knowledge and skills in order for it to function properly.

A solar operated pump system needs special attention, maintenance and operation. Because the pump relies on the sun for power there are important details that need attention. Although there is no need for electricity or fuels such as diesel, there are solar panels and batteries. These are expensive items that need special care. There is also the added risk of theft, so security becomes a concern for such systems. In this handbook we will deal with these issues. It is recommended that the Borehole Operator's Handbook is also referred to alongside this handbook.



Who is the handbook for?

This handbook is meant for operators of boreholes that have pumps driven by solar power.

What does the handbook contain?

In this handbook we share important information on the operation of solar powered pumps.

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.

"A solar pump is different to a diesel pump"

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

OVERVIEW OF A SOLAR POWERED BORHOLE SYSTEM

WHAT?

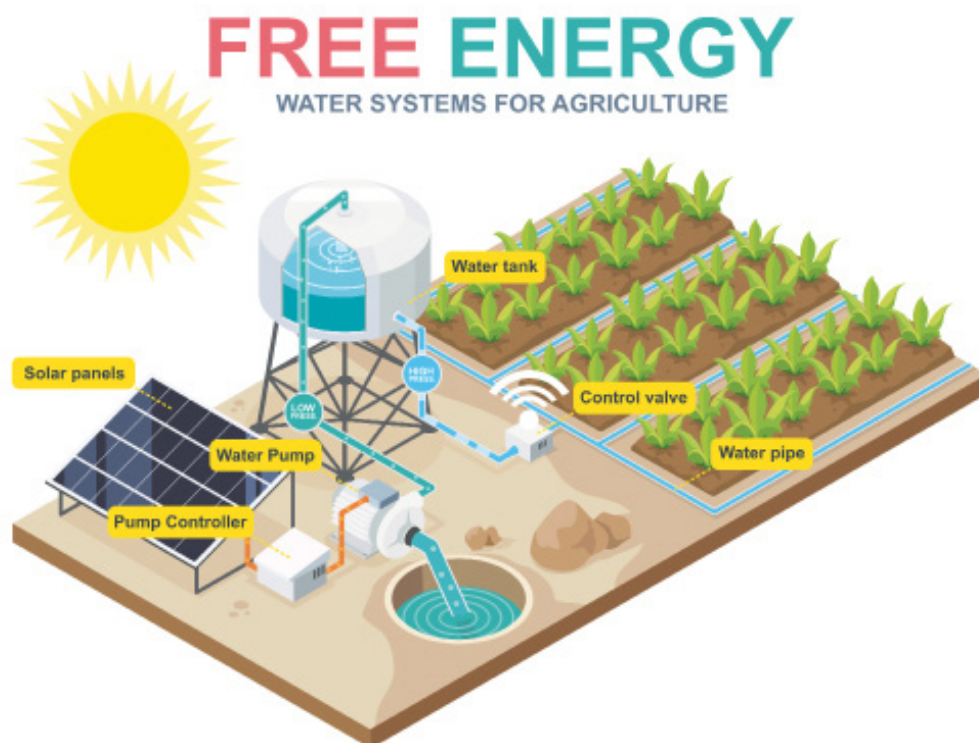
What is the difference between a solar powered system and other power generating system?

A solar powered system makes use of solar energy (radiation) either to power the pump directly or to store energy in batteries. In the Giyani area, there is more than sufficient solar radiation to supply energy during daytime throughout the year. Other power generating systems make use of non renewable sources of energy (fossil fuels). This is the case of grid electricity that is billed monthly or power generators that require purchase of liquid fuel. Although the cost of installing solar panels is high, solar energy is renewable and it can be harvested at no cost.

HOW?

How does the solar powered borehole system work?

Water is lifted from the borehole pump and flows up the riser pipe, via the borehole headworks, through the rising main to the storage and then into the reticulation until the water points. It works in the same way that a diesel pump works except that the energy or fuel source is the sun's energy that can be stored in a battery. You can however have a system that does not have batteries but then it will only pump when there is sunshine.



WHAT?

What are the functions of each component on the solar powered system?

Solar panels

- Photovoltaic array-Converts solar energy to D.C. electricity.

Inverter (DC to AC)

- Used for power conditioning for high power application.

Regulator

- Regulates voltage.

Wires

- For electrical power transmission.

DC Motor

- Converts electrical output of the solar panels into mechanical energy.

AC Motor

- Converts electrical output of the solar panels into mechanical energy.

Belt and Pulleys

- Used for turning the shaft in the rising main.

Submersible Pump

- Pump with an attached motor. Both pump and motor are below the water level in the borehole.

Mono Pump

- A rotary pump mainly with discharge head, rising main and the pump element.



TASK 2

MAINTENANCE OF YOUR SOLAR PUMP

WHO?

Who should maintain the solar-powered ground pumping system?

Pump Operator: A person on the ground responsible for the day-to-day operation and maintenance of the system (e.g. a farmer or a community Water Committee member).

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)

What are the essential routine maintenance checks?

Maintenance of solar-powered groundwater pumping system does not require particular skills. Maintenance needs to be done to anticipate possible problems, react timeously to servicing needs and ensure high efficiency and longevity of the system.

The maintenance check is done by the Pump Operator. On the next pages is a checklist that they can follow.

HOW?

How do you keep records of the maintenance of the solar-powered ground pumping system?

The upkeep of a log book is strongly recommended for maintenance. This can include records on:

- Costs incurred for replacements and services. (bills, dates, brief description of cause)
- Findings during maintenance visits. (maintenance checklist)
- System failures (date, description)



MAINTENANCE CHECKLIST

Activity	Frequency	Troubleshooting
Check if the system is working	Daily	<p>If the pump is not working:</p> <p>a) check the water source and pipes (is there any dirt, blockage, enough water?);</p> <p>b) check the electronics (are there any burned parts, loose wires, emergency lights?).</p>
Weekly inspections	Weekly	<p>a) energy generated by the solar panels;</p> <p>b) pump performance (pumping rate);</p> <p>c) condition of water source (purity of water);</p> <p>d) condition of controller and electronics (visible signs of malfunctioning);</p> <p>e) blockage of pipes or emitters (on farm);</p> <p>f) condition of water storage facility and pipes (leaks, water level);</p> <p>g) condition of solar panels and their mounting system (stability, cleanness).</p>
Cleaning of solar panels	Every two to four weeks	<p>a) use clean water and cloth covered sponge or soft brush to scrub off the most persistent grime;</p> <p>b) clean in the early morning or late evening, when panels are cool;</p> <p>c) do not step or walk on the panels as they could be damaged</p> <p>d) Hot panels should not be sprayed with cold water – they might crack.</p>
Quarterly inspections	Every two to three months	<p>a) no plants grow close to the panel, the mounting structure, water source, controller, junction box;</p> <p>b) there is no shade on the panels (plants, poles, fences etc.), so as to permit maximum radiation;</p> <p>c) fencing of the solar array is not damaged;</p> <p>d) mounting structures are stable;</p> <p>e) clean regularly the reservoir and flush the water treatment system and/or filters;</p> <p>f) inspect after strong winds, hail storms, <u>lightening</u>, floods or other weather extremes have occurred in your area.</p>



What Maintenance procedures are required for different system components of the solar powered system?

1. The submersible pump

The submersible pump is manufactured to a very high specification and will operate on a daily basis without problem for at least 5 years, probably many more. The motor is contained within the pump and is cooled by the water passing over it. It has built in protection features, which together with the control panel ensure that it is protected from risk of overheating, drop in water level, or voltage fluctuations.

2. The control unit(s)

Depending on the system in place there may be a simple on/off control unit or a more sophisticated control panel with a digital display. In the event that there is a backup power source, there may be two switches or control units. These are to protect the pump, and should not be tampered with in any way and should only be installed and maintained by a qualified electrician. The most common reason for solar pumps getting damaged is because an unqualified person tried to fix it. Incorrect wiring can bypass the inbuilt protection features of the system and cause brand new equipment to be permanently and irreparably damaged.

Maintenance tasks include dusting the control panel on a weekly basis.

3. Solar panels (photovoltaic modules)

These have no moving parts and there is very little that technically can go wrong with them. Consequently, many of them have up to 20-year manufacturer's guarantee. The main risks to the panels is from theft, vandalism or children throwing stones which causes damage. Theft in particular is a major problem in most areas, so water committees need to ensure thorough security measures are in place to minimize these threat and panels are well secured.

4. Motors

Some DC motors need replacement brushes; this is usually a simple operation (far simpler than, e.g. servicing a small engine powered pump). Brushes will probably need to be replaced after two years of operation.

5. Inverter (AC) Automatic Regulator (DC)

Install away from sunshine, it is usually affected by heat more than 20-25°C. If the temperature rises more than this, the system switches off and vice versa. This switching on and off is not good. Should be kept away from water. It is an enclosed system and should not be tampered with.

6. Electrical wiring

Wiring should be placed in conduits and buried underground and in case of replacement use the right wires (ultra-violet rays resistant).

7. Pulleys and belts

Check tension and replace damaged or worn out ones. Exposed terminals (on panels or inverter) should be checked regularly for corrosion or damage if they are installed.



HOW?

Maintenance of water source and pumps:

The water source needs to be clean and free of sand, sediments or aquatic plant growth. Pumps can last up to 10 years if maintained well

Maintenance of solar panels and mounting structure:

Solar panels need to be kept clean and free of shade, Stable and protected from animals and falling objects. Solar panels and mounting structures can last up to 20 years if maintained.

Maintenance of electronics and controls:

Controllers/inverters are sensitive to overheating. Moderate ambient temperature, ventilation and low humidity must be ensured. They should be easily accessible for service and maintenance purposes and there has to be a circuit breaker between the photovoltaic generator and the controller.

Maintenance of water treatment system and filters:

Maintenance requires a certain level of technical knowledge and skills depending on the type of water purification system and filters. The water treatment system and/or filters need to be flushed/cleaned regularly and depending on the water quality, this can be done even daily. When using hard water (with high dissolved lime concentrations), scaling up and clogging of pipes will occur, especially if pipes are exposed to heat (direct sunshine).

WHAT?

What activities should be followed after installation of the system to ensure proper maintenance?

- Ensure that operation and maintenance manuals of the equipment are provided by the manufacturer or supplier, with instructions for operation, maintenance, troubleshooting and warranty papers.
- Ensure field inspections take place regularly, especially in the first few months of operation.
- Appoint a responsible person for routine maintenance.
- Do not try to repair defective components on your own as you may lose the warranty on the equipment.

TASK 2

TROUBLE SHOOTING

WHAT?

What are the common installation mistakes and troubleshooting?

Problem	Remedy
<i>Dangerous cable connection</i>	Use rubber tape to insulate wires, especially during the rainy season
<i>Galvanic corrosion of a manual tracking solar panel system</i>	Cover with a protective sealant, especially steel, zinc and aluminium parts.
<i>Limited heat dissipation capability of corroded controller housing</i>	Provide some ventilation to the housing to prevent high humidity and <u>over-heating</u> .
<i>Accumulated grime at the lower end of a solar panel</i>	Remove grime by scrubbing with a cloth covered sponge or soft brush with clean water.
<i>Shadowing by not well-maintained ground vegetation</i>	Cut/prune vegetation surrounding solar panels to prevent shading that lowers power generation.

What are the system potential unexpected problems and what might be the cause?

Problem	Probable Cause	Possible Solution
<i>Low or no power/slow motor (less water pumped)</i>	Poor electrical connection due to dirt; Wet or corroded terminals; Insufficient sun	Clean, dry or replace the terminals
	Dusty solar panels	Wipe out dust
<i>System switching on and off</i>	Inverter/regulator poorly installed	Install away from sunshine/water
<i>Motor stops</i>	Worn out brushes	Replace brushes
<i>Water leaking from discharge head (mono pump)</i>	Leaking pump gland seal	Tighten pump gland nuts slightly (do not overtighten)

RECOMMENDATIONS

INSTALLATION

1. Site Selection and Assessment:

- Carefully select borehole sites with adequate ground-water resources and suitable geological conditions.
- Conduct a hydrogeological assessment to determine the borehole's yield potential.

2. Proper Sizing and System Design:

- Size the solar-powered system appropriately based on water demand and solar resource availability.
- Design the system to match the borehole's capacity and depth.

3. Quality Equipment and Components:

- Use high-quality solar panels, pumps, controllers, and other components to ensure reliability and longevity.
- Consider the use of submersible solar pumps for increased efficiency and reduced maintenance needs.

4. Effective Pump Placement:

- Ensure that the pump is correctly positioned in the borehole to maximize water extraction and minimize wear and tear.

5. Protection and Security:

- Implement security measures to prevent vandalism and theft of solar panels and equipment.
- Protect the borehole and equipment from physical damage, environmental factors, and pests.

6. Compliance and Regulations:

- Comply with local regulations and permitting requirements for borehole installations.
- Seek necessary approvals from relevant authorities.

MAINTENANCE

7. Regular Inspection:

- Establish a routine inspection schedule to monitor the condition of solar panels, pumps, controllers, and other components.
- Check for any signs of wear, damage, or performance issues.

8. Cleaning and Maintenance of Solar Panels:

- Keep solar panels clean and free from dust, dirt, and debris to maintain their efficiency.
- Inspect and clean panels as needed, especially in dusty or arid environments.

9. Battery Maintenance:

- If the system includes batteries, regularly inspect and maintain them to ensure optimal performance.
- Check battery electrolyte levels, connections, and charging efficiency.

10. Pump Maintenance:

- Maintain the submersible pump by inspecting seals, bearings, and impellers for wear and tear.
- Lubricate and replace parts as recommended by the manufacturer.

11. Controller and Inverter Care:

- Inspect the solar controller and inverter for proper operation and connections.
- Address any faults or errors promptly and ensure proper grounding.

12. Monitoring and Data Collection:

- Implement remote monitoring systems to track system performance and detect issues in real-time.
- Keep records of system data, including water output, solar energy production, and any maintenance performed.

13. Emergency Response Plan:

- Develop a contingency plan for responding to system failures or emergencies.
- Ensure that qualified personnel can quickly address critical issues.

14. Training and Capacity Building:

- Provide training to local personnel responsible for system maintenance and operation.
- Build local capacity to handle routine maintenance tasks and minor repairs.

15. Spare Parts and Tools:

- Maintain a supply of essential spare parts and tools to facilitate on-site repairs and replacements.
- Ensure that local technicians have access to these resources.

16. Documentation and Reporting:

- Maintain comprehensive records of maintenance activities, repairs, and component replacements.
- Report issues and resolutions to relevant stakeholders and authorities as needed.

By following these recommendations for both installation and maintenance, you can maximize the efficiency, reliability, and lifespan of solar-powered borehole systems, ensuring that they continue to provide clean water to communities and contribute to sustainable development.

**Water meters
must be
protected!**

They are sensitive and expensive.





Water Research Commission
Virginia Molose – virginiam@wrc.org.za
www.wrc.org.za

Association for Water and Rural Development (AWARD)
Derick du Toit – derick@award.org.za

Tsogang Water and Sanitation
Kenny Phasha – kennyphasha@tsogang.org

University of Western Cape
Prof Nebo Jovanovic - njovanovic@uwc.ac.za