

MUFUTULI VINEYARD MINISTRIES

SITE SURVEY REPORT

Clean Water & Solar Power Project

Chirundu, Southern Province, Zambia

Project:	Mufutuli Clean Water & Solar Power Project
Client:	Mufutuli Vineyard Ministries
Survey Engineer:	Paul Gibbons (Project Engineer)
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1. Executive summary

This report presents the findings of a site survey conducted at Mufutuli Vineyard Ministries in Chirundu, Southern Province, Zambia on March 22-23, 2026. The survey was conducted by project engineer Paul, accompanied by Brother Charles Simoonga (site manager).

The purpose of the survey was to assess the site for installation of a 100kW off-grid solar power system, three GENAQ Nimbus N500 atmospheric water generators, and associated infrastructure to provide clean water, reliable electricity, and food security for the orphaned children at Mufutuli.

The survey confirms that the site is suitable for the proposed installation. A hybrid split-container layout is recommended, with the solar array and power electronics located on the western cleared farmland, and the water generation equipment located near the school and orphanage buildings to the east.

2. Site overview

Location: Mufutuli Vineyard Ministries, Chirundu, Southern Province, Zambia

Coordinates: Approximately -15.74°S, 28.85°E

Elevation: ~400m above sea level

Climate: Tropical savanna (Aw). Hot season 35-42°C, cool season 15-25°C. Rainy season Nov-Apr.

Annual solar irradiance: ~5.5-6.0 kWh/m²/day (excellent for PV)

Average humidity: 50-80% (suitable for atmospheric water generation)

The property comprises an orphanage, a school, a church, guest housing, a farmhouse, and extensive agricultural land including banana, papaya, and maize plantations. The Kafue River borders the property to the south and east.

2.1 Existing structures

- Farmhouse — main residential building with existing 3-phase blue electrical panel
- School / classrooms — multiple buildings with desks, computers, ceiling fans, fluorescent lighting
- Dormitory — children's living quarters
- Church — community gathering space
- Guest house — visitor accommodation
- Farm buildings — storage and agricultural facilities

3. Existing electrical infrastructure

3.1 Grid supply

The property is supplied by ZESCO (Zambia Electricity Supply Corporation) via an 11kV overhead high-voltage distribution line. A pole-mounted step-down transformer is located centrally on the property, stepping down to 400V 3-phase / 230V single-phase.

Transformer type: Pole-mounted, 11 kVA (confirmed)

HV supply: 11kV, 3-phase overhead lines

LV distribution: 400V 3-phase / 230V single-phase

Metering: Digital ZESCO meter mounted on transformer pole

3.2 Distribution from transformer

From the meter box at the transformer pole, two separate feeds distribute power across the property:

1. Feed 1 — Pump: 3 wires (3-phase 400V) running to the Kirloskar irrigation pump at the river. Cable route is overhead/surface-run, approximately 150m.
2. Feed 2 — Farmhouse/School: 1 bundled 4-core cable (3-phase 400V + neutral) running to the farmhouse main distribution board, which sub-feeds the school. Cable route is overhead, approximately 250m. Site survey video confirmed 4 conductors within a single sheathed cable.

Note: Site survey video review confirmed that both the school and farmhouse receive 3-phase supply via a 4-core bundled cable (L1, L2, L3, N) from the meter pole. The farmhouse DB is the main distribution point for the property, with the school DB as a sub-feed. Both existing DB enclosures are in poor condition and require replacement with weatherproof enclosures as part of the installation.

3.3 Grid reliability

Zambia is currently experiencing severe rolling blackouts due to reduced output from the Kariba Dam caused by drought since 2024. The Kariba Dam provides approximately 43% of Zambia's electricity. Blackouts regularly disrupt the school and farm operations. This is the primary driver for the off-grid solar installation.

4. Existing water and irrigation infrastructure

4.1 Kirloskar irrigation pump

The existing irrigation system is powered by a Kirloskar centrifugal pump located on the bank of the Kafue River, approximately 150m south of the transformer.

Pump type: Kirloskar centrifugal pump

Power rating: 37kW (estimated)

Supply: 3-phase 400V from ZESCO transformer

Location: Pump pit near Kafue River, under corrugated metal shelter

Condition: Operational. Paul inspected the pump and motor assembly on site.

Monthly electricity cost: \$1,500 (US\$18,000 per year)

The pump draws water from the Kafue River for irrigation of the banana, papaya, and maize plantations. The existing pump and pipework will be retained and powered by the new solar system via a dedicated 50kW variable frequency drive (VFD).

4.2 Drinking water

Currently, drinking water for the orphanage and school is sourced directly from the Kafue River. Women and children carry water from the river in buckets. The river water is untreated and presents significant health risks. This is the primary humanitarian driver for the GENAQ atmospheric water generation system.

5. Key distances (Google Earth verified)

Route	Distance	Heading
Transformer to Pump	150m	217.49° (SSW)
Transformer to Farmhouse	250m	67.39° (ENE)
Proposed solar site to Pump	~160m	SSW
Proposed solar site to School	~270m	ENE
Proposed solar site to Transformer	~40m	NE
Container 2 (GENAQs) to School	~40m	Adjacent

6. Proposed installation layout — hybrid split-container

After evaluating the site, a hybrid split-container approach is recommended. This optimises solar exposure for the PV array, reuses all existing cable infrastructure from the meter pole, and places the water generation equipment adjacent to the school where the water is consumed. The existing distribution boxes at the school and farmhouse are replaced with new weatherproof enclosures.



Figure 1: Mufutuli Installation Layout — Solar system and water system locations overlaid on satellite imagery

6.1 Container 1 — Power electronics (west site)

Location: Western cleared farmland, adjacent to solar array

Contents: 2x 50kW 3-phase hybrid inverters (redundant), 300kWh LiFePO4 battery bank, 1x 50kW pump VFD, main distribution board, transfer switches

Concrete pad: 6.1m x 2.4m reinforced concrete slab

Finish: Gloss white paint for solar reflectivity, extraction fans, shade structure above

6.2 Solar array (west site)

Location: Immediately south of Container 1, on cleared flat farmland

Panels: ~168x 595W bifacial panels (JA Solar or equivalent)

Total capacity: 100kW

Orientation: North-facing (southern hemisphere)

Tilt angle: ~15° (optimal for latitude -15.7°)

Array area: ~40m x 25m (1,000m²)

Mounting: Ground-mount racking on concrete footings

Expansion: Additional cleared area available to the south for future panel additions

6.3 Container 2 — Water generation (east site)

Location: Adjacent to school and farmhouse buildings

Contents: 3x GENAQ Nimbus N500 atmospheric water generators, 3x 600L food-grade water storage tanks, small distribution board

Concrete pad: 6.1m x 2.4m reinforced concrete slab

Finish: Gloss white paint, louvred vents for GENAQ air intake, extraction fans, shade structure above

Water distribution: ~30m pipe run to school/orphanage, gravity or low-pressure feed

Security: Adjacent to inhabited buildings for 24/7 oversight

7. Cable runs and electrical design

Route	Distance	Type	Load	Cable size
Solar array to Container 1	~10m	DC	100kW	Per string design
Meter pole to pump	150m (existing)	3-phase AC	37kW	Existing
School DB to Container 2 (NEW)	~30m	3-phase AC	15kW (3x GENAQ)	6mm ²
Meter pole to farmhouse	270m (existing)	3-phase (existing)	~14kW max	Existing
Container 1 to meter pole (NEW)	~40m	Power source mgmt	Solar feed to panel	Existing

The existing cable runs from the meter pole to the pump (150m, 3-phase) and to the school/farmhouse (270m, 4-core 3-phase) are retained and reused. The new meter pole panel connects directly to these existing cables. The only new cable run required is a short 3-phase connection (~30m) from the school distribution board to Container 2, providing power to the three GENAQ N500 water generators. The school and farmhouse distribution boxes are both replaced with new weatherproof enclosures as part of the installation. A distribution board at Container 2 manages the GENAQ circuits locally.

8. Power source management and redundancy

The system is designed to run entirely from solar power. A new weatherproof distribution panel mounted on the meter pole replaces the existing rusty distribution boxes and contains all source-switching logic in a single enclosure. Two transfer switches inside the panel allow each load group to be independently switched between the solar system and the ZESCO grid, providing three operating modes.

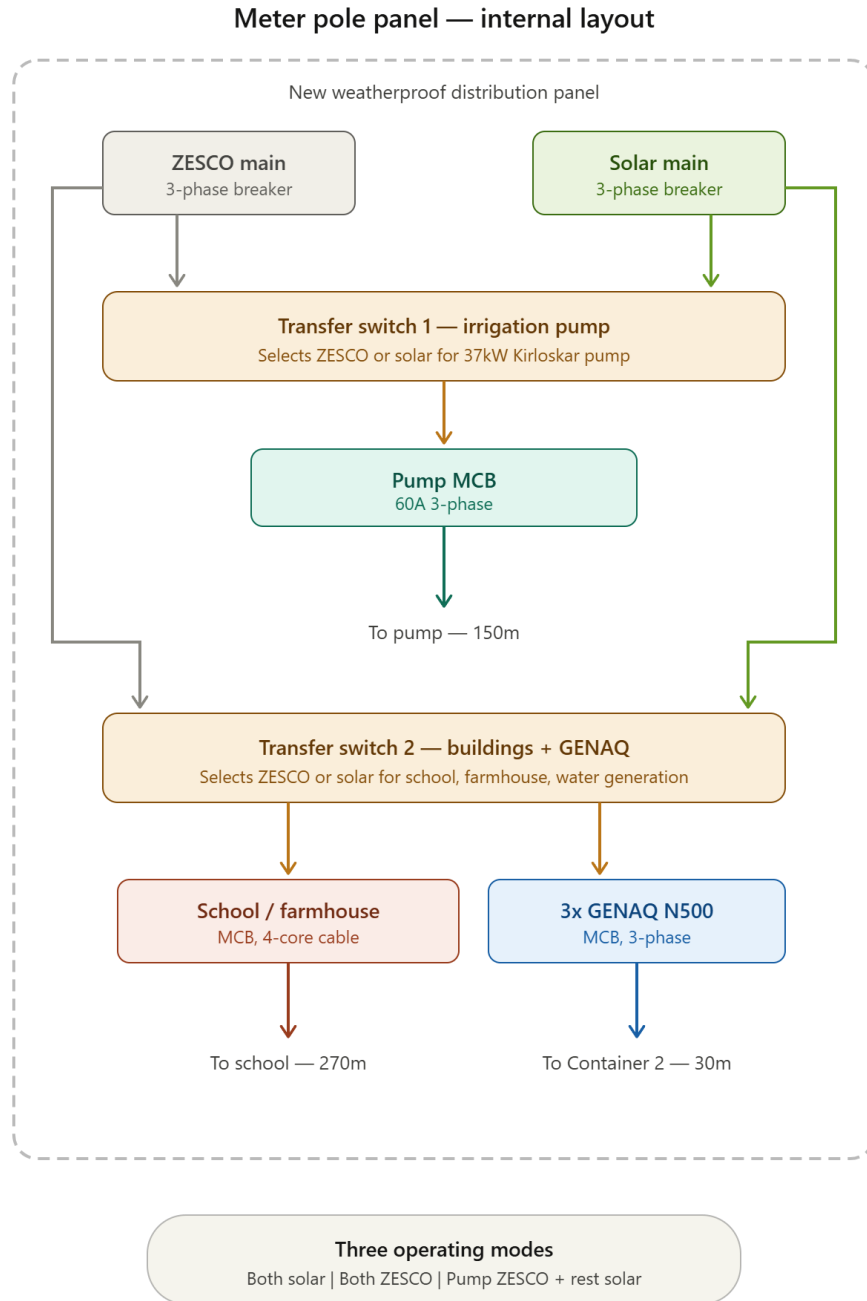


Figure 2: Meter pole panel schematic — dual source with independent transfer switches

1. Transfer switch 1 — Irrigation pump: Selects between solar inverter output and ZESCO 3-phase grid for the 37kW Kirloskar pump. Dedicated feed lines from both the ZESCO main breaker and the solar main breaker enter the switch independently. Output via a 60A 3-phase MCB to the pump cable run (150m).
2. Transfer switch 2 — Buildings and GENAQs: Selects between solar inverter output and ZESCO grid for the school, farmhouse, and three GENAQ N500 atmospheric water generators. Dedicated feed lines from both sources enter the switch independently. Output via MCB to the school/farmhouse (existing 4-core cable, 270m). Container 2 (GENAQs) is fed from the school distribution board via a short 30m 3-phase connection.

The new meter pole panel contains: ZESCO 3-phase main breaker, solar 3-phase main breaker, transfer switch 1 (pump), transfer switch 2 (buildings and GENAQs), and individual outgoing MCBs for each circuit. All source-switching logic is centralised in this single enclosure, replacing the existing rusty distribution boxes at the school and farmhouse.

Mode 1 — All solar: Both switches set to solar. The entire site runs from the 100kW solar array and 300kWh battery bank. This is the default operating mode, eliminating the \$18,000 annual electricity bill.

Mode 2 — All ZESCO: Both switches set to grid. Used during solar system maintenance or fault conditions.

Mode 3 — Split source: Pump switch set to ZESCO, building switch set to solar. Used during extended dry periods when heavy irrigation is required. The pump draws unlimited power from the grid while the solar/battery system is reserved for buildings and GENAQ water generation. The 300kWh battery bank provides approximately 20 hours of building and GENAQ operation without solar input.

9. Equipment summary

Equipment	Specification	Location
Solar panels	~168x 595W bifacial	West site
Hybrid inverter A	50kW 3-phase, grid-forming	Container 1
Hybrid inverter B (redundant)	50kW 3-phase, grid-forming	Container 1
Battery storage	300kWh LiFePO4	Container 1
Pump VFD	50kW 3-phase	Container 1
GENAQ Nimbus N500 (x3)	506 L/day each, 5.1kW, 400V 3-ph	Container 2
Water storage tanks (x3)	600L food-grade	Container 2
Shipping containers (x2)	20ft, gloss white, ventilated	West + East
Transfer switches (x2)	3-phase changeover, dedicated feeds	Meter pole panel

10. Recommendations and next steps

1. Soil testing for concrete pads — confirm ground bearing capacity at both container locations for the reinforced concrete slabs.
2. Detailed solar shading analysis — confirm no tree shading affects the proposed array location at any time of year, particularly during winter when sun angle is lower.
3. Vehicle access assessment — confirm that 20ft container delivery trucks can access both the west and east sites via the existing farm track and access roads.
4. Water pipe routing — plan the 30m pipe route from Container 2 to the school water distribution point.
5. GENAQ air intake design — Container 2 requires large louvred openings for the GENAQs to draw humid air. Consult GENAQ for recommended ventilation specifications.

11. Conclusion

The Mufutuli site is well-suited for the proposed off-grid solar and water generation installation. The hybrid split-container layout maximises solar exposure for the PV array while placing the water generation equipment where it is most needed — adjacent to the school and orphanage.

The existing electrical infrastructure (transformer, distribution, pump cabling) supports full redundancy via a new centralised distribution panel on the meter pole containing two transfer switches with dedicated feed lines from both ZESCO and the solar system. The default operating mode is all-solar, eliminating dependence on the unreliable ZESCO grid and the \$18,000 annual electricity cost. The transfer switches provide the flexibility to run any load group from ZESCO when required for maintenance or heavy irrigation periods.

Upon completion, the system will provide 1,500 litres of clean drinking water per day from atmospheric water generation, 100kW of reliable solar electricity for the school, orphanage, and farm operations, and solar-powered irrigation eliminating the current electricity bill.

Water. Air. Light. Three elements. One mission.

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