UPGROW PILOT FARM, PHASE 1: BUILDER'S CONSTRUCTION PACK

This pack tells the builder exactly what to build on plot UPI 1/02/01/06/8649 in Bumbogo, Gasabo, so that 10 aeroponic towers (7 regular 52-site towers and 3 high-density 196-site towers, from Agrotonomy) can be installed and operated on a clean, drained, level, covered site, and so that the future 9.6 x 16 m greenhouse can be erected later without moving anything built now.

SHEET INDEX

Sheet	Title	Scale	Who uses it
S00	Cover, index, scope, key decisions, how to read the pack	-	Everyone
S01	Site location, plot geometry, survey data, setting-out rule	1:200	Surveyor, foreman
S02	Master site plan, phase 1, with area schedule and capacity	1:100	Everyone
S03	Setting-out plan: frame zone, pads, tower centres, post positions, levels	1:50	Foreman, mason
S00b	How to read these drawings: colours, lines, symbols and words explained for non-builders	-	Upgrow team
S04	Construction details: pad section, footing, tank stand, soak pit, land drain, wash floor, specs	1:10 to 1:40	Mason, plumber
S05	Phase-1 shade / rain frame: plan, section, member schedule	1:75 / 1:100	Welder / steel fabricator
S06	Water, RO, nutrient dosing and drainage plan with process flow	1:100	Plumber
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S08	Bill of quantities (no prices), every line tagged 1a / 1b / 1c	-	Pricing, Upgrow finance
S09	Build sequence, 6-week programme, hold points and sign-off checklist	-	Foreman, Upgrow site manager
S10	Design basis, assumptions and permits	-	Upgrow management
DXF	Upgrow_Pilot_Site_Plan.dxf: CAD file with layers, for any surveyor or engineer	1:1 (m)	Surveyor, engineer

THE BUILD IS IN THREE STAGES. THE BUILDER PRICES STAGE 1a NOW; 1b AND 1c ARE OPTIONS.

Stage	When	What	Rough cost (USD, before quotes)
1a Plant-ready	Now, before the towers land	10 concrete pads, gravel round the two blocks, one 2000 L tank on a block plinth, pipe from the WASAC meter, manifold and 10 laterals, RCD board and 4 outdoor sockets, open drainage ditch, poles + shade net over the towers, site cleared and levelled	2,000 to 3,000 with Upgrow labour
1b Weatherproof	Before the first full rainy season	Steel frame with poly roof and insect net (replaces poles), buried land drain and soak pit, second tank on 2 m stand, RO and booster, wash/pack and store sheds, battery backup, fans, gate and fence repairs, full-plot gravel	12,000 to 18,000
1c Greenhouse	When the CFGET greenhouse is bought	Greenhouse erected on the reserved footprint, optional slabs under the blocks, phase-2 towers, cold room, solar	Greenhouse 12,000 to 15,000 landed, plus works

SCOPE OF THE FULL DESIGN (all three stages together; every item on the drawings is tagged with its stage)

1. Clear, strip and level the plot; cut and fill the frame zone to a single formation level.
2. Ten 800 x 800 concrete pads, one per tower, tops all at one level, tower IDs painted on (1a). Optional full slabs per block later (1c).
3. Gravel over the whole plot except slabs, buildings and the soil brine bed: entry yard, aisles, phase-2 zone, service strip, perimeter path.

4. Galvanised steel shade / rain frame 9.6 x 10 m, 3.5 m clear, with poly roof, 30 % shade net and roll-up insect-net sides.

5. Raw water stand for 2 x 2000 L tanks, RO cabinet, 1000 L RO tank, brine tank, nutrient station stand.

6. Wash / pack station 2.4 x 3 m (roofed, concrete floor with gully). Store 2.4 x 3 m (lockable, houses DB and battery). Both 1b.

7. Drainage: slab falls, 100 mm land drain along the frame east edge, 75 mm wash drain, roof gutter to 1000 L rain tank, soak pit 1.5 x 1.5 x 1.5 m.

8. Plumbing from the WASAC meter to all points on S06. Electrical from the REG meter to all points on S07.

9. Gate 3.0 m, boundary fence check, edge restraint for gravel, soil brine bed 0.8 m along the west boundary.

NOT in phase 1: the CFGET greenhouse (its footprint is reserved and nothing on this pack conflicts with it), cold room, solar array (conduit and roof space are provided), phase-2 towers.

WHAT CHANGED IN REV P2 (design review, 9 Sep 2026)

1. Ten individual 800 x 800 pads replace the two big slabs. Same tower positions, 80 % less concrete. Slabs stay on the drawings as a dashed later option.

2. Everything is staged 1a / 1b / 1c on the plans, the details, the bill of quantities and the build sequence.

3. Wash/pack and store sheds narrowed to 2.4 m and pulled 0.6 m off the east boundary, to keep clear of any setback argument with the district.

4. Stage 1a drainage is an open ditch along the low side; the buried pipe and soak pit move to 1b. Water tank starts on a 0.6 m block plinth; the 2 m stand is 1b.

5. Fans, insect net and the poly roof move to 1b: they only make sense once there is a rigid frame. Stage 1a cover is poles and shade net on the same post positions.

6. A plain-words box was added to every drawing and a "How to read these drawings" sheet (S00b) was added for the non-builder reader.

KEY DECISIONS BUILT INTO THIS PACK (confirmed by Upgrow, 8 Sep 2026)

Decision	What was decided	Why it matters to the build
Access	Gate on the SSW short side (downhill side)	Entry yard, meter assumptions, soak pit at the low SE corner, deliveries reverse in from the road
Utilities	WASAC tap and REG grid both exist on the plot	Meter positions on S06 / S07 are assumed near the gate: the plumber and electrician confirm on day 1 and adjust pipe / cable runs, nothing else changes
Block B use	The 3 high-density towers are a dedicated baby greens line	Separate slab, own timer circuit, placed next to the wash / pack station because cut greens are washed and bagged within minutes
Tower height	All 7 regular towers run at full 2.9 m under the frame	Frame height 3.5 m clear, roof net and poly, frame doubles as wind protection and becomes the greenhouse skeleton position
Orientation	Tower rows run along the plot long axis (bearing 25°)	Agrotonomy asks for north-south rows; at 1.9° S latitude the sun is near overhead and 25° off north has no measurable effect. Frame and future greenhouse share this axis

HOW TO READ THE PACK

All plan dimensions are in metres from beacon P1 (the south-west corner) along the X axis (the 15 m access side) and the Y axis (the 20.2 m long side). Detail dimensions on S04 are in millimetres. Levels are relative to the top of the Block A slab (+0.000). Colours: grey = concrete, dotted beige = gravel, dark green = regular towers, light green = high-density towers, blue = water, cyan = RO water, red = electrical, brown = drainage, purple dashed = future greenhouse. Every sheet carries the same north arrow: grid north is 25° anticlockwise from the +Y axis.

If a sheet and the site disagree (a beacon is missing, the WASAC meter is on another side, rock is found at 300 mm), the builder stops that item and calls the Upgrow site manager. Nothing gets improvised on site without a note on the S09 checklist.

HOW TO READ THESE DRAWINGS (for the non-builder)

A construction drawing is a map with rules. Once you know the six rules below, every sheet in this pack reads the same way.

THE SIX RULES

1. Plans look straight down. Sheets S02, S03, S06 and S07 are views from directly above, like a satellite photo. You see the tops of things: a tower is a circle, a post is a small square, a tank is a circle, a shed is a rectangle.

2. Sections look sideways through a cut. Sheet S04 and the right half of S05 slice through the ground and the structure and show the layers, like cutting a cake. Ground is at the bottom, sky at the top.

3. Everything is measured from one corner. The red dot P1 is the corner of your plot on the road side, on your left when you face the plot from the road. Every position is "so many metres across, so many metres up" from P1. Example: tower A1 is at (3.40, 6.90): 3.40 m along the road-side boundary, then 6.90 m up into the plot.

4. Numbers with arrows are distances. A line with an arrowhead at each end and a number in the middle is a dimension: the distance between the two ends. Plans use metres (3.00), details use millimetres (800).

5. Dashed means "not now" or "hidden". A dashed outline is something planned for later (the purple greenhouse, the grey optional slabs) or something buried (drains, cables). Solid lines are things you build in the stage shown.

6. North is not up. The plot is drawn square on the page so it is easy to measure. Real north points up and to the left, shown by the arrow marked N. On S01 only, the plot is drawn the way the land title shows it, with north up.

COLOURS AND SYMBOLS

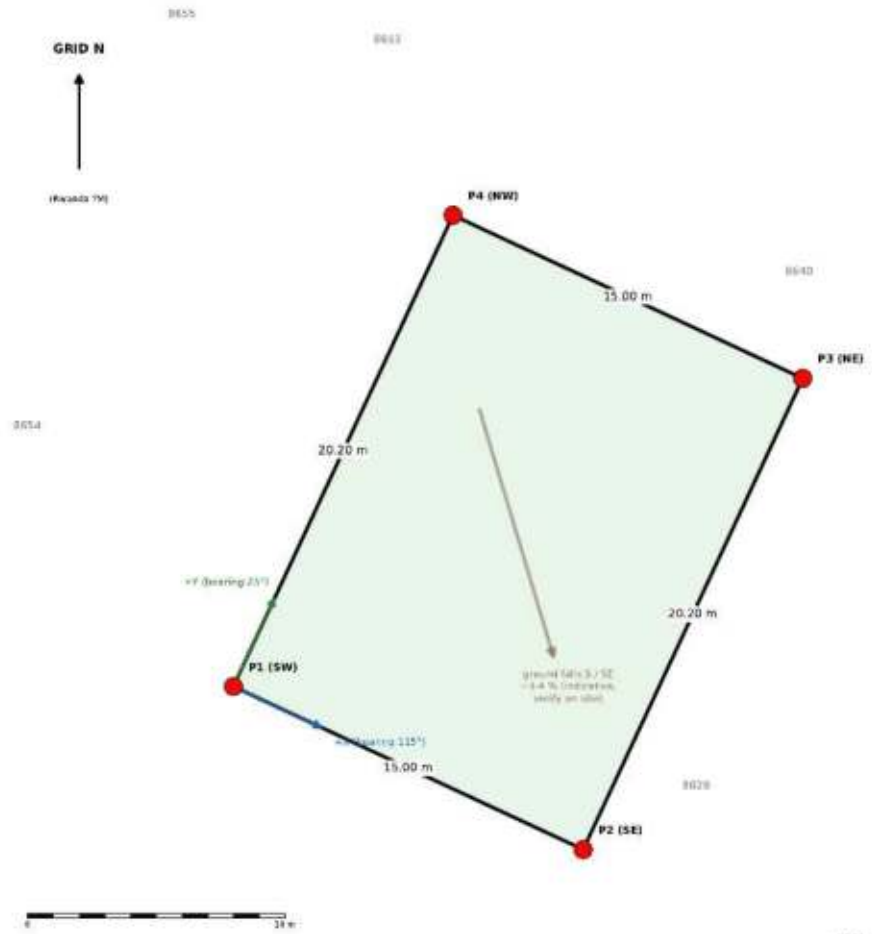
Colour	What it looks like	What it is
	Grey square or rectangle	Concrete. In stage 1a: the ten 0.8 x 0.8 m pads, one under each tower. Dashed grey = the optional big slab later.
	Beige speckled area	Gravel: 20 to 40 mm clean crushed stone, 70 to 100 mm deep, on a cloth. This is the ground surface everywhere you walk.
	Dark green circle	A regular 52-site tower (Block A, the 15-crop trial). The faint halo around it is how wide the plants will spread.
	Light green circle	A high-density 196-site tower (Block B, baby greens). Three of them, next to the wash point.
	Black rectangle with small black squares	The roof frame. Each small square is a post. Stage 1a: wooden poles with shade net. Stage 1b: steel with poly roof.
	Purple dashed rectangle	Where the real greenhouse (9.6 x 16 m) will stand later. Only pads and posts go inside it now.
	Pale green box with crossed benches	Propagation: the tables where seedlings grow before going into the towers.
	Pale blue box with circles	Nutrient station: the tanks that mix fertiliser into the water (stage 1b when the Dosatron is installed).
	Blue circle	A water tank. Two large ones for tap water, a smaller one for filtered water, one for rainwater.
	Orange-tinted box	A shed: wash/pack station or store. Stage 1b.
	Solid blue or black line	A water pipe. Black = tap water, blue = filtered water, thin green = the small pipe to each tower.
	Brown dashed line	Drainage: where rain and wash water flow away. Ends at the soak pit (hatched square) in the low corner.

	Red line	Electrical cable. Solid = buried main cable, dashed = cable on the frame. S in a circle = outdoor socket.
	Brown hatched strip on the left	A soil bed along the west boundary where the salty water from the RO filter is used on ordinary plants (stage 1b).
	Red dots P1 to P4	The four boundary beacons: the concrete markers at the corners of your land. P1 is the measuring origin.

WORDS THE BUILDER WILL USE

Word	Meaning
Setting out	Marking the positions on the ground with pegs and string before digging.
Datum	The one reference height everything is measured from. Here: the top of the pads = 0.000.
Formation	The level of the ground after stripping and compacting, before any hardcore goes on.
Hardcore	A compacted layer of murram or crushed rock that spreads the load and stops the ground moving.
Geotextile	A tough cloth laid under gravel so it does not mix with the soil and weeds do not grow through.
C20 / 1:2:4	The concrete mix: 1 part cement, 2 parts sand, 4 parts stone, by volume.
Mesh / BRC	A steel grid inside concrete so it does not crack.
Fall	A deliberate slight slope so water runs off. 0.4 % means 4 mm drop per metre.
RCD	The safety switch on the electrical board that cuts power in a fraction of a second if electricity leaks, essential where water and power meet.
Manifold / lateral	The main feed pipe along the aisle, and the small pipe that branches off it to each tower.
Float valve	A tap that shuts itself when the tank or tower reservoir is full, like a toilet cistern.
Hold point	A step in the build where work stops until Upgrow has checked it and signed the S09 checklist.

PLOT 8649 IN GRID-NORTH ORIENTATION (scale 1:200)



TITLE DATA (Icyemezo cy'iyandikishwa, 28/12/2024)

UPI	1/02/01/06/8649
Registered area	304 m² (drawing computes 303.8 m²)
Location	Kigali City / Gasabo / Bumbogo / Nyabikenke / Masizi
Land use on title	"Guturira" = residential (see permit note)
Leaseholder on title	NSHIMYIMANA Dieudonne, 100 %
Tenure	49-year state lease from 28/12/2024. No 8647/0/AS/BGM/NYA/001
Shape	Rectangle 15.0 x 20.2 m, long axis bearing 25° (NNE-SSW)
Access	60W short side (downhill), per owner
Utilities	WASAC tap and REG grid on plot, per owner; meter positions to be confirmed
Elevation	~1434 m (SRTM). Falls S/SE ~3-4 %, i.e. 0.6-0.8 m over plot length
Coordinate system	Rwanda TM (ITRF2005, CM 30°E, k 0.9999, FE 500000, FN 10000000)

BOUNDARY BEACONS (digitised from title sketch, ±0.3 m)

Beacon	Local X	Local Y	Easting	Northing	Latitude	Longitude
P1 (SW)	0.00	0.00	514988.62	4787439.00	-1.922513	30.134736
P2 (SE)	15.00	0.00	515001.88	4787431.77	-1.922583	30.134853
P3 (NE)	15.00	20.20	515010.39	4787450.28	-1.922414	30.134979
P4 (NW)	0.00	20.20	514997.34	4787457.66	-1.922348	30.134812

SETTING-OUT RULE FOR THE BUILDER

1. Find the four physical boundary beacons. If any is missing, a licensed surveyor re-establishes it from the UPI. Do not guess.
2. P1 = the beacon at the south-west corner (downhill corner on the access side, left when standing on the road facing the plot).
3. Local X axis = string line from P1 to P2 (the access side, 15.0 m). Local Y axis = string line from P1 to P4 (the long side, 20.2 m).
4. Check the diagonal P1-P3: it must measure 25.16 m. If it is off by more than 5 cm, stop and call the surveyor.
5. Every element on sheets S02 to S07 is dimensioned from P1 along X and Y. Set out with two tapes, mark with pegs and lime.
6. Level survey: take ground levels at P1...P4 and at the four slab corners before any excavation. Record them on the S08 checklist.
7. Datum: top of block A slab = +0.300. All levels on the drawings are relative to this datum.
8. Grid-north coordinates are for a surveyor with GPS/total station only. Builders work from the beacons and string lines.

IN PLAIN WORDS (for non-builders): what the lines and colours mean

This is your plot drawn the way it appears on the real title, with north at the top. The four red dots are the boundary beacons (like corner markers in the ground). P1 is the corner on the road side, on your left when you face the plot from the road.

All the short cross-arrows are drawn "tilted" so the plot sits square on the page, that is why the north arrow is not straight up and to the left. The table gives the actual positions for a surveyor; a builder only needs the beacons and a tape.

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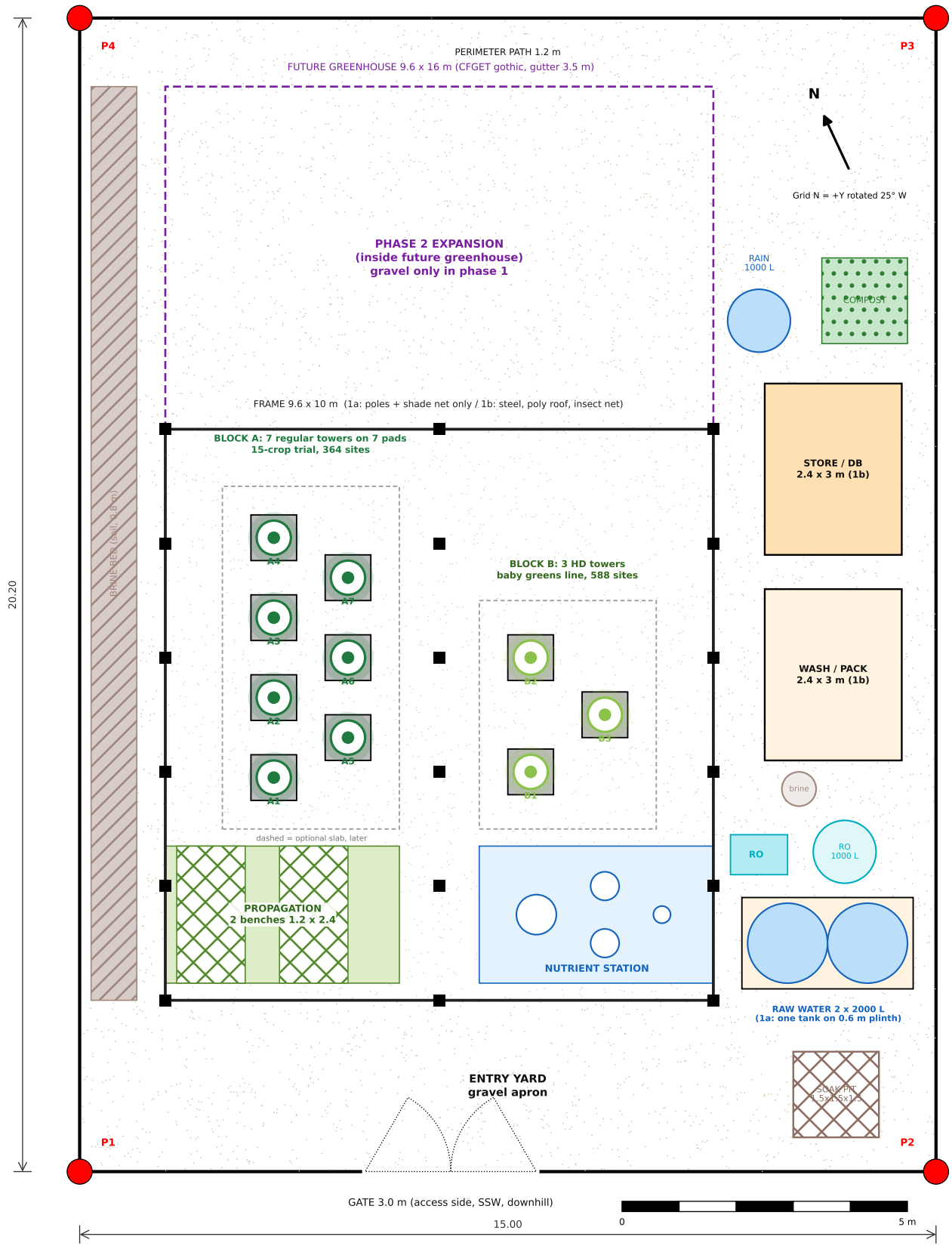
UPI: 1/02/01/06/8649, Masizi, Nyabikenke, Bumbogo, Gasabo, Kigali

SITE LOCATION, PLOT GEOMETRY AND SURVEY DATA

Sheet S01 · Scale 1:200 @ A3 · Date 09 Sep 2026

Rev P2 - STAGED BUILD (La / Lb / Lc), PADS NOT SLABS, PLAIN-WORDS NOTES ADDED

Prepared by Henry Rukundo & Grace Sengabo (Upgrow AI Geo Assistant)



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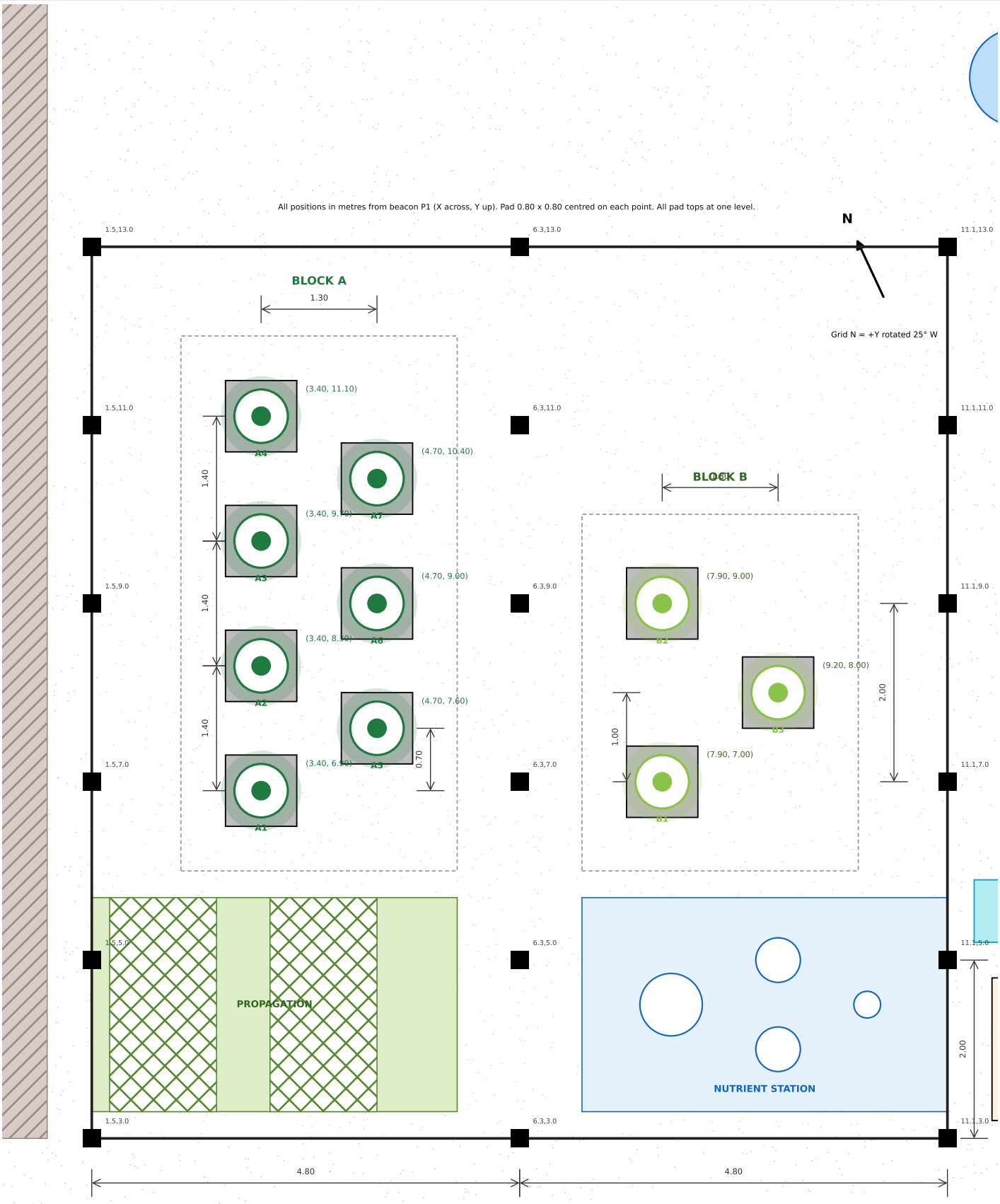
MASTER SITE PLAN - PHASE 1 (A4 edition; legend on S00b)

Sheet S02 Scale 1:100 @ A4 Date 09 Sep 2026

Rev P2 - STAGED BUILD (1a / 1b / 1c), PADS NOT SLABS, PLAIN-WORDS NOTES ADDED

Prepared by Kenny Rubaduka & Sage Gasuku (Upgrow AI Ops Assistant)



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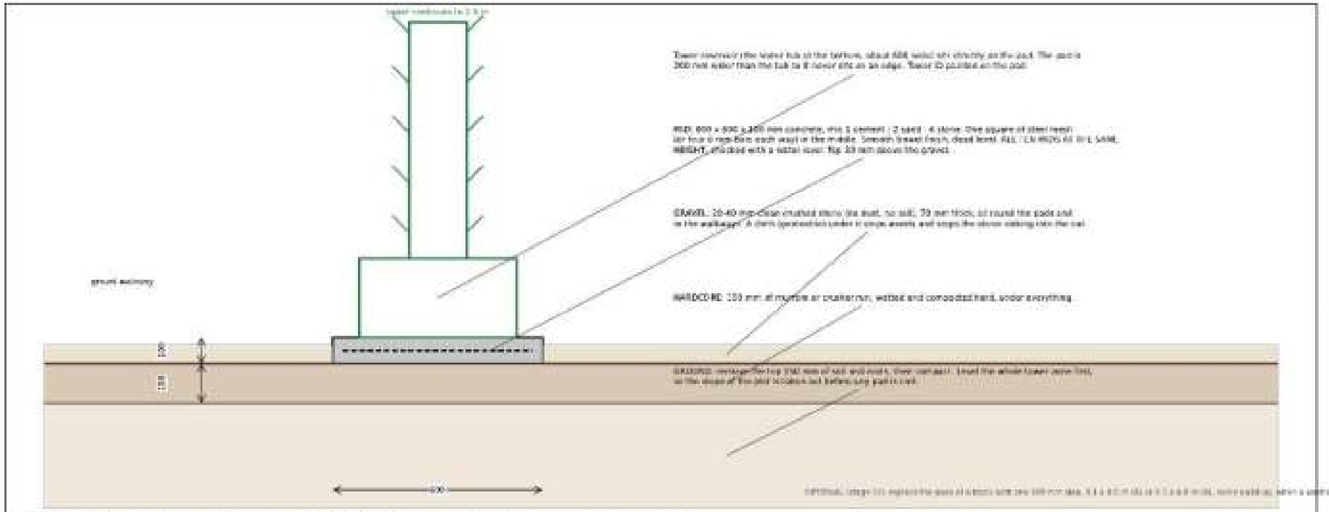
UPI 1/02/01/06/8649, Masizi, Nyabikenke, Bumbogo, Gasabo, Kigali

SETTING-OUT PLAN - PADS, TOWER CENTRES, POSTS (A4 edition)

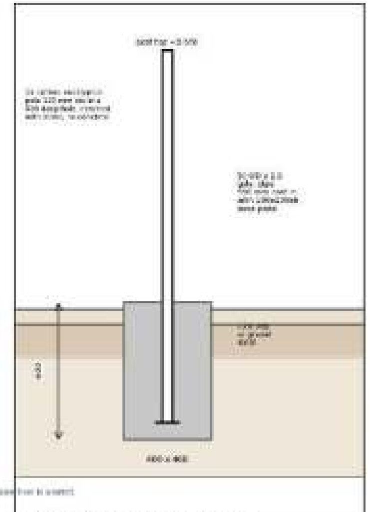
Sheet S03 Scale 1:60 @ A4 Date 09 Sep 2026

Rev P2 - STAGED BUILD (1a / 1b / 1c), PADS NOT SLABS, PLAIN-WORDS NOTES ADDED

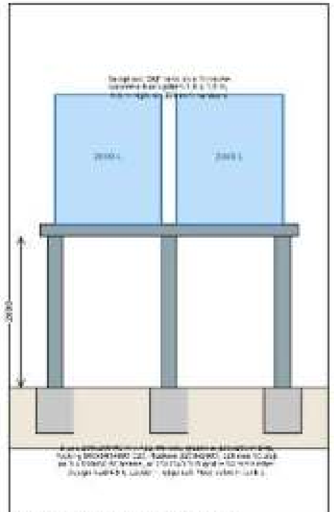
Prepared by Kenny Rubaduka & Sage Gasuku (Upgrow AI Ops Assistant)



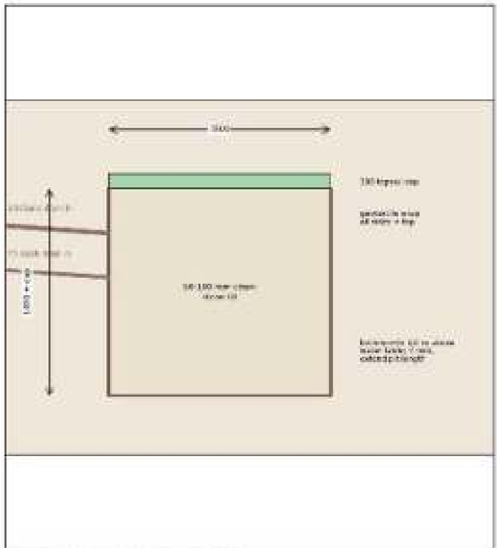
DETAIL 1 TYPICAL SECTION THROUGH ONE TOWER PAD AND THE GRAVEL AROUND IT (1:12, mm) [stage 1a]



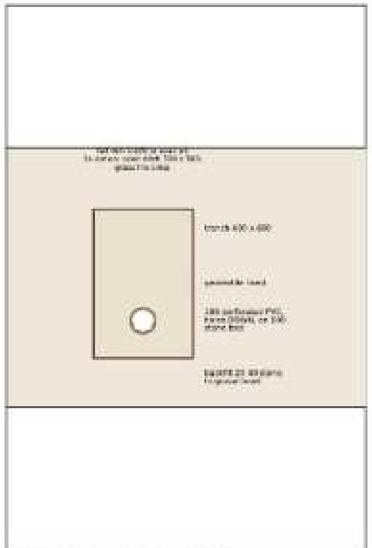
DETAIL 2 POST FOOTING (1:12) [1b]



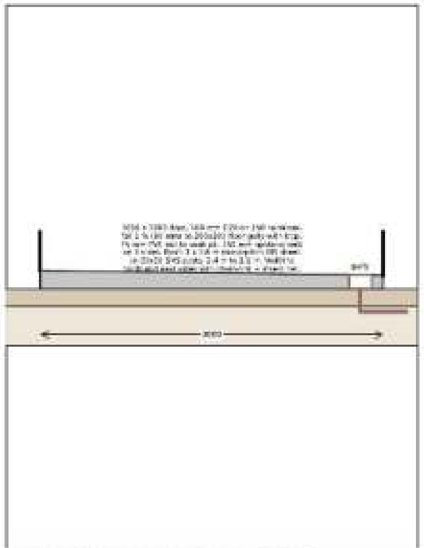
DETAIL 3 WATER STAND (1:40) [1b]



DETAIL 4 SOAK PIT (1:25, mm) [1b]



DETAIL 5 LAND DRAIN (1:10) [1b]



DETAIL 6 WASH / PACK FLOOR (1:25, mm) [1b]

GRAVEL, STORE AND FINISHES SPECIFICATION

IN PLAIN WORDS (for non-builders)/ what the lines and colours mean

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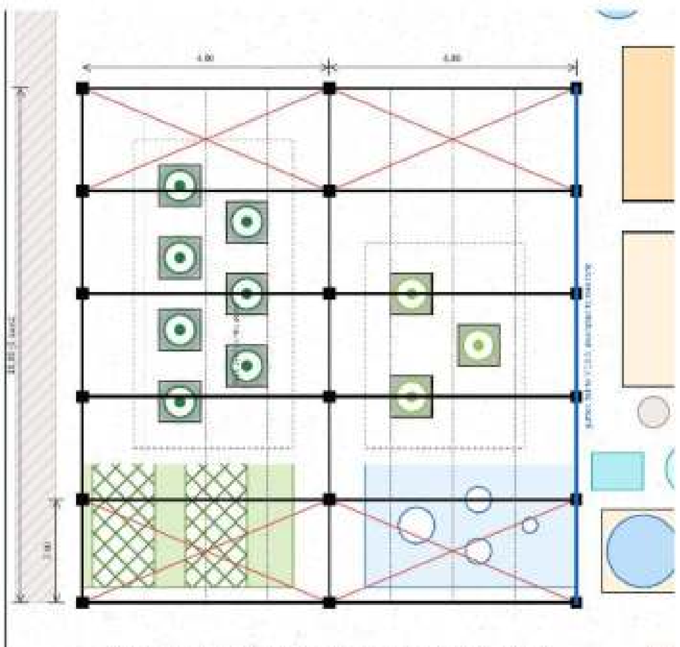
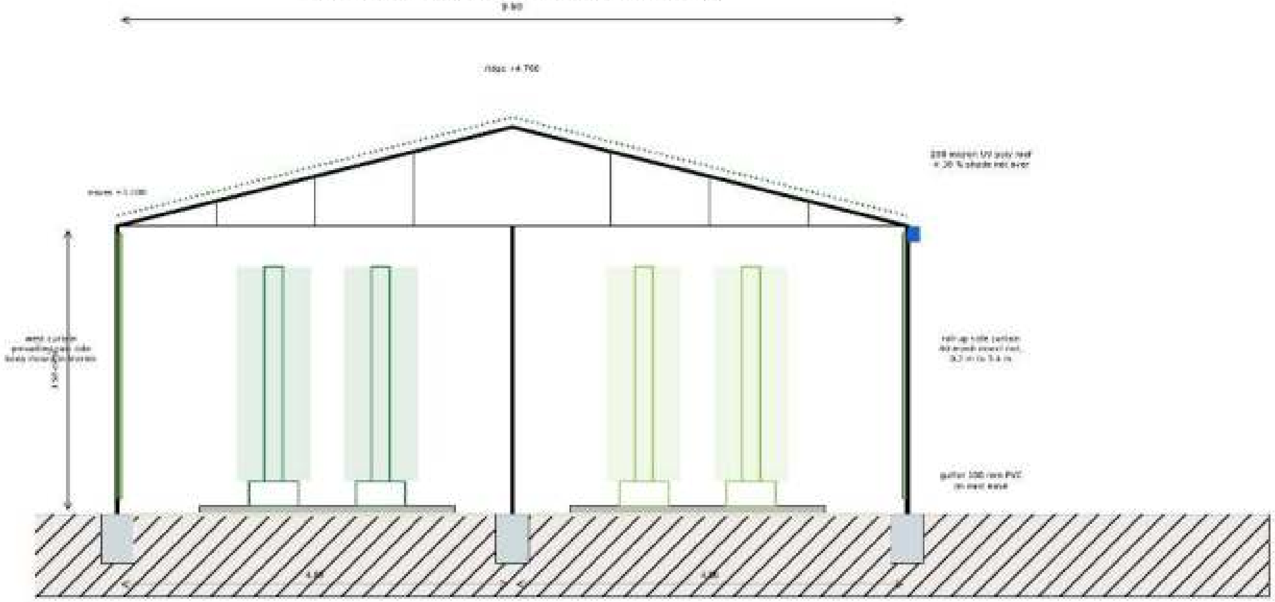
CONSTRUCTION DETAILS - PADS, GRAVEL, FOOTINGS, DRAINS, TANK STAND



FRAME PLAN 1:100 (red = diagonal wind bracing, end bays, both roof planes)

CROSS SECTION THROUGH FRAME AT Y = 9.0, LOOKING NNE (1:75)



MEMBER SCHEDULE (all galvanised steel)

Posts	18 no. 50 mm OD x 2.5 mm pipe, 4.1 m long (0.55 m footing, 3.5 clear), 100x100x6 base plate
Trusses	6 no. gable trusses, span 9.6 m or two 4.8 m halves over centre post. Top chord 40 mm OD x 2.0, bottom chord 32 mm OD x 2.0, verticals 20 mm OD at 1.2 m. Rise 1.2 m at ridge.
Ridge and eaves	3 no. 40 mm OD pipes x 10 m running along Y at X 1.5, 6.2, 11.1, clamped to trusses
Purlins	4 lines of 25 mm OD pipe at 1.2 m along the slope, clamped, running 10 m
Bracing	8 no. 20 mm OD diagonals (or 8 mm rod with turnbuckle) in end bays, both slopes; plus knee braces post to truss at every post
Roof cover	200 micron UV poly, 12 x 11 m sheet, fixed with wiggle wire in lock channel on eaves and gable ends; 30 % black shade net 12 x 11 m over, on 2 mm wire lines at 1.2 m
Sides	40-mesh anti-thrip net 3.0 m high on all four sides, roll-up bar 25 mm OD with hand crank on the two long sides, fixed on gable ends. Door 1.2 x 2.1 m double net door at SSW gable (X 5.6-6.8)
Gutter	100 mm PVC half round on east eave, fall 1:200 to Y 12.0; 75 mm downpipe with leaf guard and first-flush diverter to 1000 L rain tank
Fixings	Pipe clamps / cross connectors 50-50, 40-25; 12 mm anchor bolts in footings; all self-tappers stainless

NOTES

All steel hot-dip galvanised after / 2 coat zinc primer + enamel.

Roof poly 200 micron UV-stabilised, 4-year life.

Shade net 30 %, fixed OVER the poly on wire lines, removable.

Side curtains 40-mesh anti-thrip net, roll-up, dropped in storms.

IN PLAIN WORDS (for non-builders) / what the lines and colours mean

Left: the roof frame seen from above. Thick black lines are the roof trusses (the triangles that hold the roof up), every 2 m. Red crosses are the diagonal braces that stop the frame racking in wind. Right: the same frame cut through as viewed from the side, with two towers drawn for scale.

Stage 1a can be much simpler: line eucalyptus poles on the same post positions with shade net stretched over, no poly, no side nets. The steel version shown here is stage 1b, before the first rainy season. Either way the posts sit on the same footings, so nothing is wasted.

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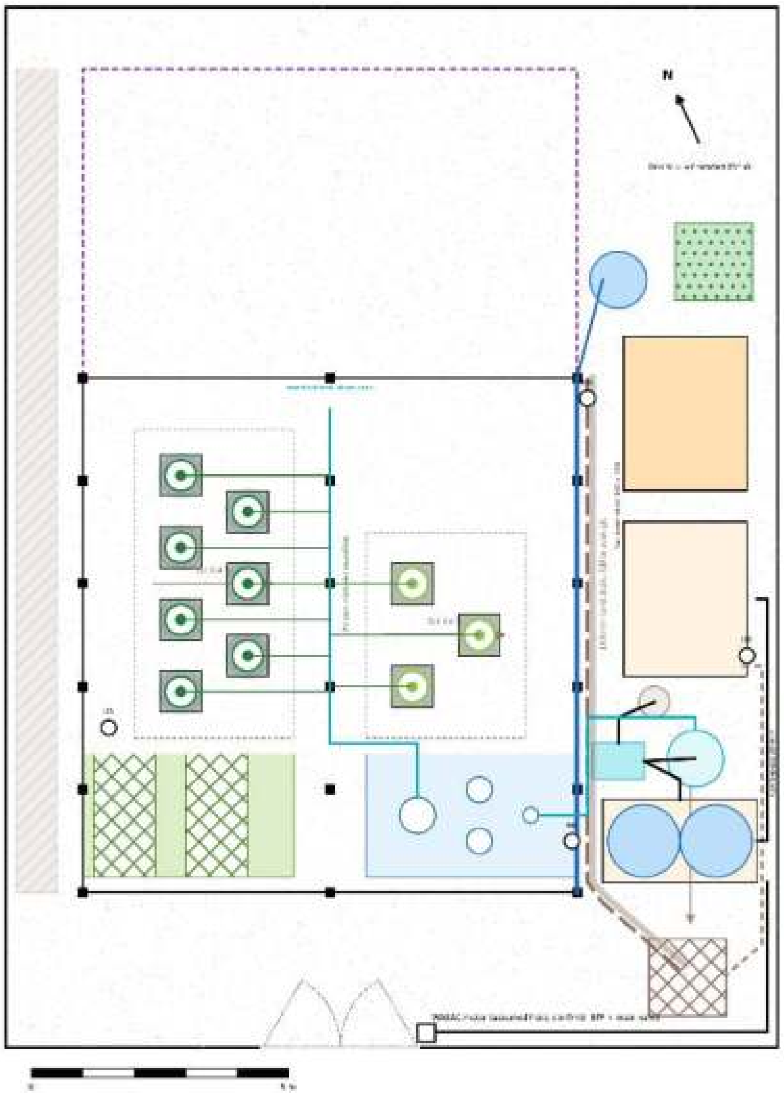
UPI: [illegible]

SHADE / RAIN FRAME - PLAN, SECTION AND ELEVATION (stage 1b steel; stage 1a poles + net)

Sheet S05 Scale 1:100 / 1:50 @ A3 Date 09 Sep 2026

Rev P2 - STAGED BUILD (1a / 1b / 1c), PADS NOT SLABS, PLAIN-WORDS NOTES ADDED

Prepared by [illegible] (Upgrow AI Ops Assistant)



LEGEND

- Raw water (WASAC) 25 mm HDPE, black
- RO water 25 mm / nutrient manifold 20 mm, blue
- Tower lateral 12 mm LDPE to float valve, green
- Land drain 100 mm perforated PVC
- Wash station floor drain 75 mm PVC
- Roof gutter 100 mm and downpipe 75 mm
- HB = hose bibb, 750 mm above floor

PROCESS FLOW (read left to right)

1. WASAC meter
2. Backflow preventer + main valve
3. 2 x 2000 L raw tanks on 2.0 m stand (float valve)
4. Booster pump 0.37 kW (0.5 HP), 2.5 bar
5. RO unit 500–1000 L/day, 1:1 brine (Agronomy: 20 ppm or less)
6. RO permeate tank 1000 L (float switch stops booster)
7. Dosatron D25RE2 x2 in series (A then B), ratio 1:200 (1:400 above 22 °C)
8. Gravity sump 250 L on 1.0 m stand, float valve
9. 20 mm manifold along centre aisle, drain cock at end
10. 12 mm lateral + shut-off + float valve at each of 10 towers
11. Tower reservoir (pump 45 W, 5 min on / 10 off)

Side streams: raw bypass (black) to wash station sinks, propagation and 4 hose bibbs. RO brine to 300 L brine tank, used by hose on the soil bed only, never on towers.

DAILY WATER BUDGET: towers 10 x 4-7 L = 40-70 L; propagation ~20 L; wash/pack 100-150 L; total ~255 L/day. RO at 1:1 means ~150 L raw for tower + propagation water. 4000 L raw storage = 10+ days of autonomy against WASAC interruptions.

NOTES

All pipe HDPE PN16 or PVC class C. Buried 450 mm in gravel zones; clipped to posts inside frame.

Tower laterals 12 mm LDPE to float valve at each tower, with 12 mm in-line shut-off valve per tower.

Nutrient line must never carry raw water: separate colour (black = raw, blue = RO, green = nutrient).

IN PLAIN WORDS (for non-builders): what the lines and colours mean

Black line = ordinary tap water from the WASAC meter to the storage tanks. Light-blue line = water after the RO filter, going to the nutrient station and then along the middle aisle as the main feed pipe. Thin green lines = the small pipe from that main feed to each tower.

Brown dashed line = drainage: where rainwater and wash water run away to the soak pit (the hatched square in the bottom corner). In stage 1a this is a simple open ditch; the buried pipe comes in 1b. HB = an outdoor tap.

The boxes on the right are the water path in order, top to bottom. Stage 1a uses stage 1, 2, 3, 8, 9, 10, 11 only: tap, one tank, then the manifold to the towers. RO and dosing (steps 4 to 7) are added later.

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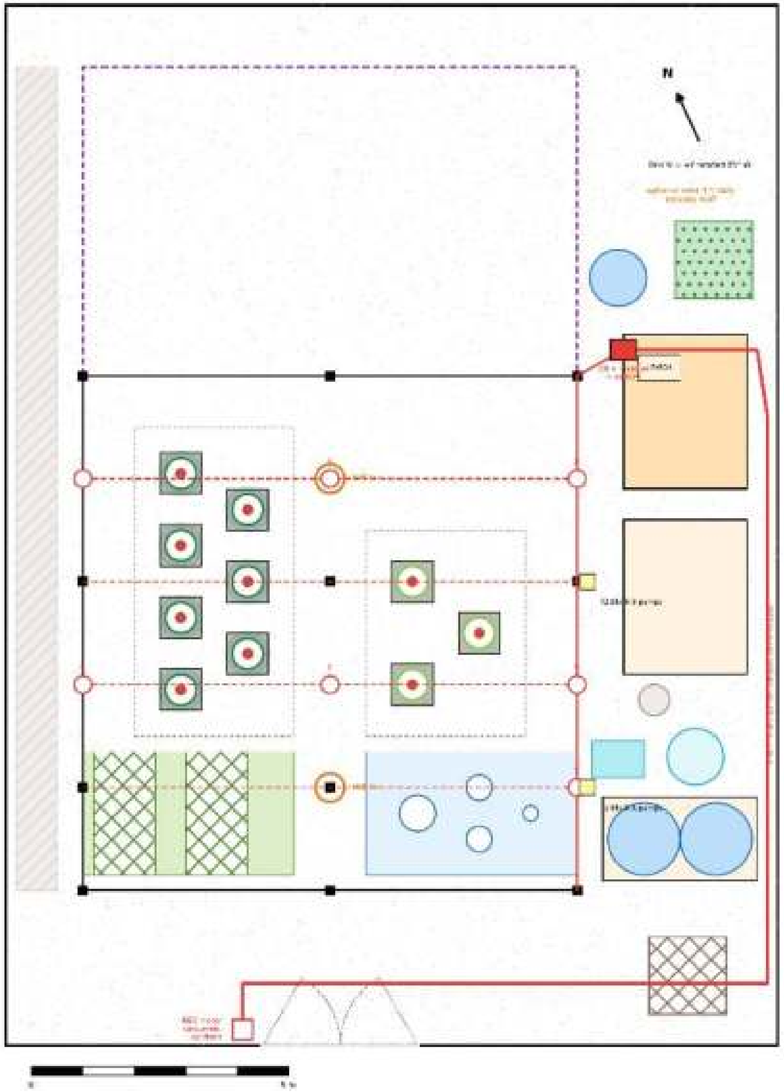
WATER, NUTRIENT DOSING AND DRAINAGE PLAN

Sheet 506 Scale 1:100 @ A3 Date 09 Sep 2026

Rev F2 - STAGED BUILD (1a / 1b / 1c); PADS NOT SLABS; PLAIN-WORDS NOTES ADDED

Prepared by [illegible] (Upgrow AI Ops Assistant)



LEGEND

- Sub-main 6 mm² Cu, buried
- Sub-circuit 2.5 mm² Cu in conduit on frame
- S = IP65 twin socket on post, 1.2 m above floor
- Tower pump 45 W plugged to nearest socket via timer
- T1 / T2 digital cyclic timer (3 min on / 12 min off)
- HAF circulation fan 100 W, 2.5 m above floor

SINGLE-LINE DIAGRAM

- REG meter, single phase 230 V, 40 A supply (confirm)
- Main isolator 40 A + SPD
- RCD 63 A / 30 mA
- Inverter/charger 3 kVA + 5 kWh LiFePO4 (critical loads only, C1-C3)
- C1 16 A Block A tower pumps (7 x 45 W) via timer T1
- C2 16 A Block B tower pumps (3 x 45 W) via timer T2
- C3 16 A HAF fans x2, propagation
- C4 16 A RO booster 0.37 kW + RO unit
- C5 16 A Wash / pack sockets, pressure washer
- C6 10 A Lighting: LED 6 no. inside frame, 2 wash, 2 store, 1 gate
- C7 16 A Spare (phase 2: cold room)

LOADS: pumps 0.45 kW, fans 0.2 kW, RO 0.5 kW, lights 0.1 kW, wash 1.5 kW peak. Design 3 kW connected, 1 kW typical. Daily energy ~7.7 kWh (towers) (Agrohomy: 0.216 kWh per tower) + ~2 kWh other. Battery 5 kWh = 24 h of pumps and fans without grid.

STORM RULE: pumps must never stop more than 30 min in daytime. The inverter carries C1-C3 automatically on grid failure. Generator inlet socket at DB for a 2 kVA petrol generator as second backup.

NOTES

All outdoor accessories IP65. Every circuit on 30 mA RCD. Earth rod at DB.

Cables in 25 mm PVC conduit, buried 500 mm with warning tape, or clipped to frame posts.

Licensed electrician only. REG connection to be inspected before energising.

IN PLAIN WORDS (for non-builders): what the lines and colours mean

Red solid line = the main cable, buried, from the REG meter to the distribution board (DB, the red box by the store). Red dashed lines = the smaller cables running along the roof frame to the sockets.

Each circle = a weatherproof double socket on a post at waist height. Each tower pump plugs into the nearest socket through a timer (yellow square) that switches it 3 minutes on, 12 off. Orange circles are the air-circulation fans (stage 1b).

The bar on the right is the fuse board: one line per circuit. Stage 1a needs only the meter, isolator, RCD (the safety trip) and circuits C1, C2 and C6. The battery box, RO and wash circuits are 1c.

UPGROW RWANDA LTD

Upgrow Rwanda Ltd - Aeroponic Pilot Farm, Phase 1 (10 towers)

UPI: [illegible], Masaka, Nyabikenke, Bumbogo, Gasabo, Kigali

ELECTRICAL PLAN AND SINGLE-LINE DIAGRAM

Sheet S07 Scale 1:100 @ A3 Date 09 Sep 2026

Rev F2 - STAGED BUILD (1a / 1b / 1c), PADS NOT SLABS, PLAIN-WORDS NOTES ADDED

Prepared by [illegible] (Upgrow AI Ops Assistant)

BILL OF QUANTITIES AND MATERIALS SCHEDULE (quantities only, no prices), TAGGED BY STAGE

Stage column: **1a** = build now, plant-ready (the builder prices only these lines). **1b** = before the first full rainy season. **1c** = greenhouse phase. Quantities include 10 % waste on bulk materials and are rounded up to purchase units. Pricing by Upgrow finance from three local quotes. m² = area, m³ = volume, lm = linear metre, no. = number.

STAGE 1a SHOPPING LIST (the short version)

Item	Qty	Note
Cement 50 kg	10 bags	10 pads + plinth
Sand / 20 mm stone	1 m³ / 1.5 m³	
Steel mesh A142 or 8 mm bars	8 m²	one square per pad
Murram (hardcore)	10 m³	under pads, plinth and 60 m² of gravel
Clean crushed stone 20-40 mm	6 m³ (~10 t)	around the two blocks + path to gate
Geotextile	80 m²	
2000 L polyethylene tank + float valve	1	on a 3-course block plinth, ~40 blocks
25 mm HDPE pipe + backflow valve + gate valve	30 m	meter to tank, tank to manifold
20 mm HDPE manifold + drain cock	12 m	centre aisle
12 mm LDPE laterals + 12 mm valves	10 sets	float valves come with towers: confirm
DB 6-way IP54 + 40 A isolator + 63 A/30 mA RCD + 3 MCBs	1	in a lockable weatherproof box on a post
6 mm² cable (or armoured) meter to DB	25 m	buried 500 mm
2.5 mm² cable + 25 mm conduit + 4 IP65 twin sockets	60 m / 4	on frame posts
Eucalyptus poles 120 mm x 4 m	18	same 18 positions as the steel posts
30 % shade net + 2 mm wire + ties	132 m² / 140 m	over towers only
Timber 150 x 50 for gravel edge	30 m	
Road-marking paint	1 L	tower circles and IDs
Labour	mason 4 days + 4 Upgrow staff 10 days	plus 1 plumber day, 1 electrician day

A. SITE PREPARATION AND EARTHWORKS

Ref	Stage	Item and specification	Unit	Qty	Notes
A1	1a	Clear vegetation, remove roots and rubbish from whole plot	m²	303	Cart away off site
A2	1b	Strip topsoil 150 mm, stockpile 10 m³ for brine bed and compost area, cart away balance	m³	46	Whole plot
A3	1a	Level survey: ground levels at P1..P4 and slab corners, set datum peg	item	1	Before excavation; record on S09
A4	1a	Cut and fill frame zone (9.6 x 10 m) to formation -0.250, compact fill in 150 mm layers	m³	22	Est. 0.2 m cut NNE, 0.2 m fill SSW
A5	1b	Cut and fill service strip and yard to grade (max 3 % surface fall to the S)	m³	12	Keep natural fall
A6	1b	Excavate slab and building formations, footings, trenches, soak pit	m³	14	Incl. 18 post footings, 3 stand footings
A7	1a	Murram / crusher-run hardcore, 150 mm compacted under slabs and buildings	m³	10	Slabs 31 m², wash 9, store 9, stand 5
A8	1b	Murram base 100 mm compacted under all gravel areas	m³	25	Gravel areas 226 m²

B. CONCRETE AND MASONRY

Ref	Stage	Item and specification	Unit	Qty	Notes
B1	1a	Blinding sand 25 mm under pads; plus 3-course block plinth 1.6 x 1.6 m for tank (40 blocks)	m³	0.3	
B2	1a	Ten tower pads 800 x 800 x 100 mm C20 with mesh, tops all at datum +0.000	m³	0.9	10 no.; incl. formwork
B3	1c	OPTIONAL slabs A (3.1 x 6.0) and B (3.1 x 4.0), 100 mm C20, replacing pads	m³	3.2	Only if a washable floor is wanted
B4	1b	Wash / pack floor 3 x 3 x 0.1 m C20 with 2 % fall to gully, 150 mm kerb on 3 sides	m³	1.3	
B5	1b	Store floor 3 x 3 x 0.1 m C20	m³	0.9	
B6	1b	Nutrient station plinth 2.4 x 1.2 x 0.1 m C20 (sump stand base)	m³	0.3	
B7	1b	Frame post footings 400 x 400 x 600 C20	no.	18	1.8 m³ concrete
B8	1b	Wash station and store roof post footings 300 x 300 x 500 C20	no.	8	0.4 m³
B9	1b	Water stand: 3 footings 500 x 500 x 600, 3 columns 200 x 200 x 2.0 m RC, platform 3.2 x 1.6 x 0.12 RC on 3 beams 150 x 200	item	1	Or steel option per S04 D3; 1.6 m³ concrete
B10	1a	BRC A142 mesh (or Y8 @ 200 both ways): 8 m² for pads (1a), 52 m² for floors and platform (1b/1c)	m²	60	Incl. laps
B11	1b	Y12 bars for columns and beams, R6 links	kg	90	
B12	1a	Cement 50 kg bags: 10 for stage 1a, 65 for 1b/1c	bags	75	C20 at 7 bags/m³ + masonry
B13	1a	Sand	m³	8	
B14	1a	20 mm aggregate	m³	12	
B15	1b	Store walls 150 mm concrete blocks, 2.6 m high, 3 sides + front with door opening, plastered inside and out	m²	30	~400 blocks
B16	1b	Concrete kerb 100 x 250 mm along plot boundary and brine bed edge (gravel restraint)	lm	90	Or 150 x 50 treated timber
B17	1c	White exterior floor paint / epoxy, 2 coats, sand in 2nd coat, on slabs A and B	m²	31	Agrotonomy: white floor
B18	1a	Road-marking paint: 10 tower circles 600 mm, IDs, manifold line	item	1	

C. GRAVEL, GEOTEXTILE, DRAINAGE

Ref	Stage	Item and specification	Unit	Qty	Notes
C1	1a	Non-woven geotextile 150 g/m²: 80 m² (1a), 210 m² (1b)	m²	290	2 m rolls, lap 300 mm
C2	1a	20-40 mm clean washed crushed stone, 70-100 mm deep: 6 m³ round the blocks + path (1a), 18 m³ rest of plot (1b)	m³	24	~40 t total
C3	1b	50-100 mm clean stone for soak pit and drain beds	m³	4.5	
C3a	1a	Open ditch 300 x 300 along the east side of the tower zone to the low corner, grassed sides	lm	16	Replaced by C4 in 1b
C4	1b	100 mm perforated PVC land drain, holes down, in 400 x 600 stone trench	lm	14	S06 route
C5	1b	100 mm solid PVC from trench end to soak pit	lm	3	
C6	1b	75 mm PVC wash drain with 200 x 200 trapped floor gully	lm	9	Plus 1 gully
C7	1b	Soak pit 1.5 x 1.5 x 1.5 m, stone fill, geotextile wrap, 100 mm topsoil cap	no.	1	
C8	1b	100 mm PVC half-round gutter on frame east eave, brackets @ 600, end caps, outlet	lm	10	
C9	1b	75 mm PVC downpipe with leaf guard and first-flush diverter to rain tank	lm	4	
C10	1b	1000 L polyethylene rainwater tank on 300 mm block plinth with overflow to land drain	no.	1	

D. SHADE / RAIN FRAME (galvanised steel, all pipe hot-dip galvanised)

Ref	Stage	Item and specification	Unit	Qty	Notes
D0	1a	Eucalyptus poles 120 mm x 4.0 m, treated, in 600 mm holes rammed with stone, at the 18 post positions; 2 mm wire lines and 30 % shade net over the tower zone	no.	18	Removed when D1 steel goes in
D1	1b	Post 50 mm OD x 2.5 mm x 4.1 m with 100 x 100 x 6 base plate welded	no.	18	
D2	1b	Truss top chord 40 mm OD x 2.0 mm	lm	66	6 trusses x 2 x 5.0 m
D3	1b	Truss bottom chord 32 mm OD x 2.0 mm	lm	60	6 x 9.6 + laps
D4	1b	Truss verticals / diagonals 20 mm OD x 1.5 mm	lm	70	
D5	1b	Ridge and eaves pipes 40 mm OD x 2.0 mm	lm	32	3 x 10 m + laps
D6	1b	Purlins 25 mm OD x 1.5 mm	lm	85	8 lines x 10 m + laps
D7	1b	Bracing 20 mm OD x 1.5 mm (or 8 mm rod + turnbuckles)	lm	60	End bays + knee braces
D8	1b	Pipe clamps / cross connectors (50-40, 40-40, 40-25), galvanised	no.	160	
D9	1b	Wiggle wire lock channel, aluminium, on eaves and gable ends	lm	40	
D10	1b	Wiggle wire (spring wire) for channel	lm	45	
D11	1b	UV-stabilised polyethylene film 200 micron, clear, 12 x 11 m	m²	132	Buy 1 sheet 12 m wide
D12	1a	Shade net 30 % black (or aluminet 30 %), 12 x 11 m	m²	132	Over the poly on wire lines
D13	1a	2 mm galvanised wire for net lines and net tensioning	lm	140	
D14	1b	Anti-thrip insect net 40 mesh, 3.6 m wide	lm	42	All 4 sides, 3.4 m high
D15	1b	Roll-up bar 25 mm OD x 10 m with manual crank and guide wires, 2 sides	set	2	
D16	1b	Double net door 1.2 x 2.1 m in 40 mm frame at SSW gable	no.	1	
D17	1b	Zinc-rich touch-up paint for cuts and welds	L	2	

E. WATER, RO AND NUTRIENT DOSING

Ref	Stage	Item and specification	Unit	Qty	Notes
E1	1a	2000 L polyethylene water tank (Rotoplast / Roto or equal) with lid: 1 in stage 1a on block plinth, 1 in 1b on stand	no.	2	S04 D3
E2	1b	1000 L polyethylene tank for RO permeate, with float switch	no.	1	
E3	1b	300 L tank for RO brine, with tap	no.	1	
E4	1a	Backflow preventer 25 mm + brass gate valve 25 mm + strainer at WASAC meter	set	1	
E5	1a	25 mm HDPE PN10 pipe, raw water, meter to tanks and tanks to RO	lm	30	
E6	1b	20 mm HDPE, raw bypass to wash station, propagation and hose bibbs	lm	35	
E7	1a	Float valves 25 mm brass (raw tanks x2, RO tank x1, sump x1)	no.	4	
E8	1b	Booster pump 0.37 kW, 230 V, 2.5 bar, with pressure switch and 24 L vessel	no.	1	Feeds RO
E9	1b	Reverse osmosis unit 500-1000 L/day, 1:1 recovery, with pre-filters (sediment 5 micron + carbon) and TDS meter	no.	1	Sized for 10-50 towers per Agrotonomy
E10	1b	Dosatron D25RE2 (or as supplied by Agrotonomy) x2, mounted on board with bypass and isolation valves	set	1	Usually shipped with the towers: confirm before buying
E11	1b	Gravity sump 250 L on 1.0 m galvanised stand, with float valve and 20 mm outlet	set	1	Usually shipped with the towers
E12	1b	Nutrient stock tanks A and B, 100 L each, with lids	no.	2	
E13	1a	20 mm HDPE manifold, centre aisle, with drain cock at end	lm	12	
E14	1a	12 mm LDPE lateral + 12 mm shut-off valve + float valve per tower	set	10	Float valves shipped with towers
E15	1b	Hose bibbs 20 mm brass on post brackets at 750 mm, with 20 m hose x2	no.	4	
E16	1b	Double stainless sink 1.2 m with drainer, on frame, plus stainless packing table 1.8 x 0.8	set	1	Wash station
E17	1b	Tower soak tank 300 L (citric acid soak), pressure washer 1.5 kW, drying rack 2 m	set	1	Agrotonomy cleaning method
E18	1a	Pipe colour marking tape: black raw, blue RO, green nutrient	rolls	3	

F. ELECTRICAL

Ref	Stage	Item and specification	Unit	Qty	Notes
F1	1a	Distribution board 12-way IP54 with 40 A isolator, SPD, 63 A / 30 mA RCD, MCBs per S07. Stage 1a: in a lockable IP65 enclosure on a post; moves into the store in 1b	no.	1	
F2	1a	Earth rod 1.5 m copper-bond + clamp + 16 mm² earth	set	1	
F3	1a	6 mm² Cu 3-core armoured (or 3 x 6 mm² in 25 mm conduit) REG meter to DB, buried 500 mm with warning tape	lm	28	Route per S07
F4	1a	2.5 mm² Cu 3-core in 25 mm PVC conduit clipped to frame posts and trusses	lm	120	
F5	1b	1.5 mm² Cu lighting circuit	lm	60	
F6	1a	IP65 twin switched sockets on post brackets, 1.2 m: 4 in 1a, 3 in 1b	no.	7	
F7	1b	IP65 sockets in wash and store	no.	4	
F8	1a	Digital cyclic timers (3 min on / 12 min off) in IP65 enclosures, T1 and T2	no.	2	Often shipped with towers
F9	1b	HAF circulation fans 100 W, 450 mm, on post brackets at 2.5 m	no.	2	
F10	1b	LED weatherproof battens 36 W: 6 frame, 2 wash, 2 store, 1 gate	no.	11	
F11	1b	Inverter / charger 3 kVA pure sine with 5 kWh LiFePO4 battery, on concrete plinth, critical circuits C1-C3	set	1	Solar-ready MPPT input
F12	1b	Generator inlet socket 16 A + changeover at DB	set	1	
F13	1b	20 mm conduit sleeves under aisles for future circuits	lm	30	

G. BUILDINGS, GATE, FINISHES

Ref	Stage	Item and specification	Unit	Qty	Notes
G1	1b	Wash / pack roof: 3 x 3.6 m IBR 0.4 mm on 50 x 50 SHS posts and purlins, 2.4 m to 2.1 m mono-pitch, gutter to land drain	item	1	
G2	1b	Wash station enclosure: chain-link 2 m + insect net on north and east sides, open to frame side	m²	14	
G3	1b	Store roof 3 x 3.6 m IBR on timber / SHS, steel door 0.9 x 2.1 with 2 locks, 2 mesh louvre vents	item	1	
G4	1b	Store shelving 2 walls x 3 tiers, battery plinth 300 mm, fire extinguisher 6 kg DCP	item	1	
G5	1b	Gate 3.0 m double-leaf steel, 1.8 m high, with pedestrian leaf, 2 posts 100 x 100 SHS in 500 x 500 x 800 footings	no.	1	
G6	1b	Boundary fence check / repair: chain-link 1.8 m on 50 mm posts @ 2.5 m where missing	lm	70	Confirm what exists
G7	1a	Propagation benches 1.2 x 2.4 x 0.9 m: stage 1a timber frame + mesh top; galvanised in 1b	no.	2	
G8	1b	Brine bed: fill 0.8 x 16 m bed with stockpiled topsoil + compost, timber edge	lm	16	
G9	1a	Compost bay 1.5 x 1.5 m, 3 timber pallet sides	no.	1	
G10	1b	Site signage: Upgrow board 1.2 x 0.8 m at gate, tower ID plates, "no entry" and hygiene signs	item	1	

LABOUR SUMMARY (for the builder to price as lump sums)

Section	Trade	Estimated crew-days
STAGE 1a total	Mason 4 days, plumber 1, electrician 1, 4 Upgrow staff 10 days, 1 hand compactor 2 days	~50 person-days, 2 weeks
A Earthworks	Foreman + 4 labourers, 1 compactor (plate) hire 5 days	25
B Concrete and masonry	Mason + 2 assistants + mixer hire	30

Section	Trade	Estimated crew-days
C Gravel and drainage	Labourers x3	15
D Frame	Welder / fabricator + 2, on site 6 days after 5 days shop fabrication	22
E Plumbing	Plumber + 1	10
F Electrical	Licensed electrician + 1	8
G Buildings and gate	Mason / carpenter + 2	18
Total		~128 crew-days, about 6 weeks with two crews

BUILD SEQUENCE, PROGRAMME, HOLD POINTS AND SIGN-OFF CHECKLIST

Hold points (HP) are stages where work stops until the Upgrow site manager has checked and signed. The builder does not proceed past a hold point without a signature in the last column.

STAGE 1a IN TWO WEEKS (do this now; the full sequence below is for 1b and 1c)

Day	Work	Check
0	Paperwork: land-use agreement, sector no-objection, confirm the Agrotonomy shipping list	HP0
1	Find beacons, set P1 peg and string lines P1-P2 and P1-P4, check diagonal 25.16 m, level survey	HP1: diagonal within 5 cm
2-3	Clear and strip the tower zone (X 1.5 to 11.1, Y 3 to 13) and a 2 m path to the gate; level to one plane; compact	HP2: Upgrow checks pegs for all 10 tower centres and 18 pole positions
4	Dig 10 pad boxes 800 x 800 x 250; 150 mm hardcore, compact; dig tank plinth base; dig ditch	
5	Cast 10 pads with mesh, tops to one datum with a water level; build block plinth	HP5: all pad tops within 5 mm of each other
6-8	Cure pads (wet, covered). Meanwhile: plant 18 poles, run wire lines; plumber lays pipe from meter, sets tank; electrician buries main, mounts DB and 4 sockets	HP8: pressure test pipe; HP9: RCD trips on test
9-10	Geotextile and gravel round the blocks and along the path; timber edge; manifold and 10 laterals to painted tower circles	HP10: no ponding after hose test
11-12	Shade net over wires; paint tower circles and IDs; clean up; handover walk	HP12: towers may be assembled

FULL SEQUENCE (all stages)

Wk	Step	Work	Check / hold point	Signed, date
0	0.1	Paperwork: written land-use agreement with the leaseholder, district / sector no-objection for the greenhouse use, WASAC and REG accounts in Upgrow's name	HP0: no site work before this is done	
0	0.2	Surveyor confirms the 4 beacons, sets P1 datum peg and 2 reference pegs outside the work area, records ground levels at P1-P4 and 4 slab corners	HP1: diagonal P1-P3 = 25.16 m ± 0.05; levels recorded below	
1	1.1	Clear and strip topsoil, stockpile 10 m³ NW corner		
1	1.2	Set out frame zone, slabs, buildings, stand, pit and trenches with pegs and lime per S03	HP2: Upgrow checks every setting-out dimension against S03 before excavation	
1	1.3	Cut / fill frame zone to formation -0.250, compact; grade service strip and yard		
2	2.1	Excavate footings (18 posts, stand, gate), soak pit, drain trenches; lay geotextile and stone in trenches and pit; lay land drain and wash drain pipes with fall	HP3: pipe falls checked with level before backfill (min 1:100)	
2	2.2	Cast post footings with posts set plumb and to line using string lines and a 4 m straight edge; posts braced for 48 h	HP4: post tops all at +3.500 ± 10 mm, plumb ± 5 mm	
2	2.3	Hardcore under slabs and buildings, compact, blind		
3	3.1	Formwork, mesh, cast the 10 pads (1a); later wash floor with gully, store floor, stand footings and columns (1b); optional slabs (1c)	HP5: all 10 pad tops at +0.000 within 5 mm. Wet cure 7 days	
3	3.2	Fabricate trusses in the workshop (6 no.) while slabs cure	HP6: first truss checked for 9.6 m span and 1.2 m rise before the rest are made	
4	4.1	Erect trusses, ridge, eaves, purlins, bracing; fit gutter; fit lock channel	HP7: frame square (diagonals equal ± 20 mm), all bracing in, all welds touched up	
4	4.2	Store walls, roofs on store and wash station, gate posts and gate		
4	4.3	Cast stand platform, install raw tanks, RO cabinet, RO tank, brine tank, rain tank plinth		

Wk	Step	Work	Check / hold point	Signed, date
5	5.1	Plumbing: meter to tanks, bypass, RO, nutrient station, manifold and 10 laterals, hose bibbs, sinks, gully	HP8: pressure test raw line 1 hour at 4 bar, no drop. Fill tanks, check floats. Run RO, TDS of permeate < 30 ppm	
5	5.2	Electrical: buried main, DB, earth, circuits, sockets, timers, fans, lights, inverter and battery	HP9: electrician's test certificate (insulation, earth loop, RCD trip time). REG inspection if required	
5	5.3	Gravel: murram base, geotextile, stone, edge kerbs; brine bed soil; compost bay	HP10: gravel clean (no fines), 30 mm below slab edge, no ponding after a hose test	
6	6.1	Roof poly and shade net, side nets and roll-ups, net door	HP11: poly drum-tight, no flapping edge; roll-ups run freely; no gaps at ground (net buried 100 mm or weighted)	
6	6.2	Paint slabs white, mark tower circles and IDs, manifold line		
6	6.3	Clean site, remove all spoil and rubbish, handover walk with this checklist	HP12: Upgrow acceptance; snag list with dates; towers may be assembled	
7	7.1	Upgrow team assembles towers per Agrotonomy manual, connects laterals and pumps, runs water only for 48 h, then nutrients	Commissioning by Upgrow, not the builder	

LEVEL SURVEY RECORD (fill in at HP1)

Point	Local X	Local Y	Ground level (m, relative to P1)	Notes
P1	0.00	0.00	0.000 (reference)	
P2	15.00	0.00		
P3	15.00	20.20		
P4	0.00	20.20		
Pad A1	3.40	6.90		
Pad A4	3.40	11.10		
Pad B1	7.90	7.00		
Pad B3	9.20	8.00		
WASAC meter				Position confirmed
REG meter				Position confirmed
Datum peg			Pad tops = +0.000 set at	

SITE RULES FOR THE BUILDER

1. No cement, oil, fuel, paint or soil washed into the drains, pit or brine bed. Wash tools in a bucket and dump on the road side.
2. No vehicles on the frame zone after the formation is compacted. Deliveries stop in the entry yard.
3. Protect the beacons and the datum peg with painted stakes. If one is disturbed, tell Upgrow the same day.
4. Clean stone means clean: any load with soil, dust or fines is rejected at the gate.
5. Every hold point needs a photo sent to Upgrow with the S09 step number in the message.
6. Workers do not enter the frame once the nets are on unless Upgrow says so: it is a food-production area from HP11.

DESIGN BASIS, ASSUMPTIONS AND PERMITS

1. WHAT THE LAYOUT IS BASED ON

Parameter	Value used	Source
Tower section diameter	22 cm; reservoir base allowed at 60 cm; canopy allowance 90 cm	Agrotonomy, Vertical Farming with Aeroponics 2024 (VFA), ch. 7
Tower heights	Regular 13-pot = 52 sites = 2.9 m; high-density 25-section = 196 sites = 2.9 m	VFA ch. 4, 7, 8
Space per tower	Under 1 m² footprint; 1.5-2 m² all-in including aisles, packing, propagation, cleaning. This layout: 96 m² frame for 10 towers = 9.6 m² each in phase 1, falling to ~2.8 m² when phase 2 fills the greenhouse	VFA ch. 20
Row pattern	Staggered double rows; Agrotonomy uses 0.9 m row spacing and 0.36 m stagger at commercial density. Pilot uses 1.3 m row spacing and 1.4 m pitch for data access and airflow	VFA ch. 36 sample layouts
Orientation	Structure and rows north-south recommended; here along the plot long axis at bearing 25°	VFA ch. 3
Floor	Concrete recommended; fall 1.25 cm per 3.5 m (0.36 %); white coating for light diffusion	VFA ch. 3
Outdoor climate window	5 °C to 32 °C open air; Kigali (1400 m) stays inside this window year-round. Rain and direct sun are the risks, hence the frame	VFA ch. 3
Hybrid greenhouse spec	Galvanised metal frame, poly roof, 25-35 % shade cloth, anti-thrip net sides, fans	VFA ch. 3
Irrigation system	Nutrient A and B tanks, gravity tank, Dosatron (2-3 units), manifolds, float and valve per tower; one system serves 100-150 towers	VFA ch. 23; Cultivation Guide ch. 80
Dosatron ratio	1:300 normal, 1:400 above 32 °C	Cultivation Guide ch. 80
Water	4-7 L per 52-site tower per day; RO recommended, quality units 1:1 brine; brine to outdoor soil plants	VFA ch. 19, 24
Power	45 W pump per tower, 3 min on / 12 min off = 0.216 kWh per tower per day; 10 towers = 2.16 kWh/day; backup power mandatory	Cultivation Guide ch. 92
Pumps	SICCE Syncra Silent 3.0 recommended	Cultivation Guide ch. 79
Cleaning	Disassemble after every cycle outdoors; citric acid soak 2 h; pressure wash; dry. Needs a soak tank and washing area	Cultivation Guide ch. 90
Propagation	Separate benches; seedlings 3-8 weeks before transplant depending on crop	Cultivation Guide ch. 91 and crop chapters
Future greenhouse	16 x 9.6 m single-span gothic, gutter 3.5 m, ridge 5.8 m, arch spacing 2.0 m, 8 mm polycarbonate	CFGET quotation CF26030055, 31 Mar 2026
Plot	304 m², 15.0 x 20.2 m, long axis 25°, residential land use, 49-year lease to Nshimiyimana Dieudonne	Land title certificate UPI 1/02/01/06/8649, 28 Dec 2024
Terrain	~1434 m; falls S/SE ~3-4 %	SRTM 30 m elevation model: indicative only, replaced by the HP1 level survey

2. ASSUMPTIONS THE BUILDER MUST VERIFY ON DAY 1

1. WASAC meter is near the gate on the east side and REG meter near the gate on the west side. If not, the plumber and electrician re-route along the boundary; all other positions stay.
2. Ground is soil, not rock, to at least 0.7 m. If rock is met in footings or the pit, footings become 300 deep with 4 x M12 chemical anchors, and the pit becomes a 6 m long trench.
3. Water table is more than 2.5 m below ground (Bumbogo hillside). If water is found in the pit excavation, stop and call Upgrow.
4. The boundary fence exists in some form. G6 in the BoQ covers repairs; a full new fence is a separate instruction.
5. A truck can reach the gate. Gravel (40 t) arrives in 5-7 tipper loads.

3. PERMITS AND PAPERWORK (Upgrow, before HP0)

1. Land-use agreement: Upgrow is not on the title. Sign a written lease or use agreement with Nshimiyimana Dieudonne (the registered leaseholder) covering at least 3 years, the right to build the frame, greenhouse and buildings, and what happens to structures at the end. Register it or at least notarise it. This also closes the "pilot-site lease" gap in the investor data room.

2. Change of use: the title says residential (Gutura). Clause 5 of the lease contract forbids changing the use without written permission; clause 8 requires permits before works. Get a written no-objection from Gasabo District (One Stop Centre) or at minimum the Bumbogo Sector for an agricultural pilot with a temporary shade structure. Ask specifically whether the CFGET greenhouse (5.8 m ridge, 153 m²) will need a construction permit later, so the phase-1 frame does not create a problem.

3. Neighbours: the frame is within 1.5 m of the west boundary and the store within 0.4 m of the east boundary. Kigali setback rules for residential plots may apply. Confirm with the sector; if a 3 m setback is imposed, the whole layout shifts 1.5 m east and the service strip narrows to 2.4 m (still workable). Do this before HP2.

4. Utilities in Upgrow's name: WASAC and REG accounts, so bills and outages are managed by the company, not the landlord.

5. Insurance: contractor's all-risk for the build; Upgrow asset cover for towers once delivered.

4. DESIGN CHOICES UPGROW CAN STILL CHANGE (before HP2)

1. Frame is 10 m of the future 16 m greenhouse footprint, on the same 2 m grid. When the CFGET arrives, the phase-1 posts come out bay by bay; slabs, drains, plumbing and power all stay. Nothing is wasted except the poly and nets, which will have reached end of life anyway.

2. Block B is next to the wash station because baby greens are cut, washed, dried and bagged in minutes (VFA ch. 7). Block A is on the west, furthest from the working traffic, because trial data needs undisturbed plants.

3. Propagation is at the entry end, not the far end, so seed trays, RO water and the store are within 5 m. Agrotonomy puts propagation at the cool north end of a climate-controlled house; in a hybrid frame at the equator the entry end is the practical choice.

4. 4000 L raw storage is deliberate. WASAC supply on Kigali hillsides is intermittent; towers cannot dry out. The stand height (2 m) also gives gravity feed to the wash station if power fails.

5. RO is included because Agrotonomy is emphatic that water quality separates good crops from mediocre ones. If cash is tight, the cabinet and pipework are built now and the RO unit is bought before towers are planted.

6. Battery before solar. The pump load is tiny (2.2 kWh/day). A 5 kWh battery covers 24 h of outages; solar panels can be added on the store roof later using the same inverter.

7. Gravel, not concrete, between blocks: cheaper, drains, and can be lifted when the greenhouse floor is poured in phase 2. Clean stone only, otherwise it turns into mud and algae in the first rainy season.