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HORTICULTURAL ENGINEERS

The Irrigation System Design Guide

A practical workbook for growers planning a new system

From the water source to the controller: what to decide, in what order, and what to ask before you get a quote.

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How to use this workbook

No two sites need the same irrigation system, and templated designs tend to show it in weak spots, uneven coverage or capacity that does not match how the land is used. This guide follows the order in which a good design is worked out, so you can do the thinking before anyone visits and judge any proposal you receive, ours included.

Each section ends with a short checklist. Write down what you know and mark what you do not. The gaps are the useful part: they tell a survey what to measure.

This workbook is general guidance, not a design or a substitute for professional advice. Electrical work, pressurised pipework, boreholes, water storage and anything involving licences should be assessed for your own site by a suitably qualified person, and you should follow the manufacturer's instructions for every component.

1. Water source and storage

Every project starts with one question: where is the water actually coming from? Get that wrong, with an undersized supply, an unlicensed borehole or no buffer for peak demand, and no amount of good design downstream fixes it.

Mains water usually avoids the licensing and testing that come with your own source, and the pressure is generally dependable, so it suits small setups and propagation. At scale the catch is cost and pressure: mains was not designed around your system's peak demand, which is why larger installations pair it with storage and a pump.

A borehole gives you your own supply and your own responsibilities. You need a hydrogeological survey to confirm the aquifer can sustain your demand, a water quality test, and above a certain volume an abstraction licence. Boreholes suit consistent, high-volume demand better than occasional use.

Reservoirs and harvested rainwater sidestep abstraction licensing almost entirely, but supply follows the weather, so size them around your driest stretch, not your average. Most commercial sites end up on a hybrid: mains or borehole for baseline supply, with storage to buffer peaks.

Abstraction licensing

The Environment Agency's published threshold for England is 20 cubic metres (20,000 litres) a day: taking more than that from a borehole, river or other natural source normally needs an abstraction licence. If you draw from the same source at several points, the combined total counts. Compare the threshold with your peak-day demand, not your average. Rules differ in Wales and Scotland, and applications go through GOV.UK. Always confirm your own position with the relevant regulator before relying on this summary, and check timescales before planning around borehole water from day one.

Sizing storage

> Storage needed = (peak daily demand x days of reserve wanted) less reliable inflow over that period, plus allowances for losses and unusable volume.

- **Peak daily demand:** built up zone by zone from crop area, method, run times and how many zones run at once.
- **Days of reserve:** how long you must keep irrigating if the source fails. This is a risk decision, not a formula.
- **Reliable inflow:** what the source genuinely delivers while you draw down, not its best day.
- **Losses:** evaporation, seepage, the volume below the outlet and freeboard.

Check the fill strategy too: storage filled once in the quiet months must hold the whole demand, while storage topped up continuously only covers the gap. Allow for expansion now.

Siting matters as much as size. Ground conditions decide the base (high groundwater can lift an empty buried tank, so have the installer or a qualified engineer advise), every inlet needs a planned overflow, and the pump needs a short suction run or enough height for gravity feed. Plan filtration at the outlet, shading against algae, level sensing and frost protection.

Checklist: water and storage

- ■ Where does water come from now, and do I have records and test results?
- ■ What is my peak-day demand, and is it near the licence threshold?
- ■ How many days of reserve do I want?

- Is there ground, access and drainage for storage, and room to expand?
- Where would an overflow discharge?

2. Crop and layout

Before pipes and pumps, a designer needs to understand your operation: crops, rotation, the corner that always stays too wet, the section that dries out first.

Map the field. Record topography, soil type, drainage and existing vegetation. Low-lying areas may hold moisture while raised ground needs more, and mapping guides where pumps, valves and pipelines go.

Match water to crop and soil. Deep-rooted crops such as maize need consistent moisture at depth, while shallow-rooted crops such as lettuce need frequent, lighter watering. Sandy soils drain quickly and suit smaller, more frequent applications. Clay retains moisture and may need less frequent watering.

Zone the site. Zones let you water areas according to need, reduce pressure fluctuations and simplify scheduling. Site shape, pressure and flow capacity, crop, distance from the source and elevation all shape them.

Design in room to grow. You may add tunnels next year or diversify crops. A design should allow for expansion and can be phased, so sections are added as budget allows.

Design so you can reach it. Valves, filters and controls should sit where you can actually get at them, and pipes and sprinklers should not interfere with cultivation or harvest.

Checklist: crop and layout

- Site plan or aerial image marking buildings, growing areas, water and power
- Crops and areas now, and planned changes
- Soil types, slopes, drainage, wet and fast-drying areas
- Proposed zones, and which crops share one

3. Drip, overhead sprinkler or both

Drip delivers water slowly at the base of the plant. Sprinklers spray from above, mimicking rainfall. That difference, targeted versus broadcast, drives everything else.

| Factor | Drip | Overhead sprinkler | |---|---|---| | Best for | High-value crops, rows, tunnels, glasshouses | Large fields, broadacre, dense planting | | Water loss | Minimal evaporation and runoff | Higher losses to wind and evaporation | | Maintenance | Filtration essential, emitters can clog | Simpler, but check nozzles and pressure | | Uniformity | Excellent, plant by plant | Good, but wind affects coverage | | Frost protection | No | Yes |

Drip suits soft fruit, salads, vines and row crops. Water stays off the leaves, which reduces foliar disease. It needs clean water and good filtration. Pressure-compensating emitters keep flow consistent on long runs and uneven ground, so row-end plants get what row-start plants get, and emitters belong close to the root zone.

Sprinklers cover large areas quickly and can protect against frost, at the price of more loss to wind and evaporation. Uniformity depends on sprinkler type, nozzle size, pressure, consistent overlap in grid or triangular layouts, and allowance for wind.

Or both. Plenty of operations run drip in the tunnels and sprinklers in the open fields. Zoning makes that one system, not two.

Checklist: delivery method

- Which crops are high-value or row-grown, and which are broadacre?
- Do I need frost protection anywhere?
- How exposed is the site to wind?
- Is my water clean enough for drip?

4. Pumps and pressure

The pump is often chosen last, after pipework and sprinklers are decided. It should be one of the first things you plan, because it determines how well everything else performs.

Selection depends on flow rate, pressure (drip lines generally need lower, steadier pressure than sprinklers), distance and elevation, the water source, and power. Size comes from the area covered, pipe run length and the pressure needed at the far end, not land size alone. Too powerful can damage pipework and emitters. Undersized leaves parts of the site dry.

| Type | Suits | Watch-outs | |---|---|---| | Centrifugal (surface) | Surface water, general use | Limited in how far it can draw | | Submersible | Boreholes, deep tanks | Sits below the water line | | Mains electric | Sites with power; anything automated | Power cuts stop irrigation; supply capacity limits what you can run | | Solar | Remote fields, off-grid tunnels | Follows weather and season; needs sizing and storage | | Engine-driven | Large peak demand away from power; backup | Fuel, servicing, noise, theft; needs attendance |

Mains pumps are easiest to automate. On a long rural cable run or single-phase supply, a soft-start or variable speed drive may ease starting, but have a qualified electrician or engineer confirm what your supply can support and carry out the electrical work. Solar works best as a hybrid with storage or a mains connection for dull spells. Unattended pumps need protection against running dry.

A well-sized tank lets a smaller pump run longer, so design storage and pumping together.

Checklist: pumps and pressure

- ■ Peak flow, with every zone that may run together
- ■ Pressure needed at the furthest point
- ■ Distance and height from source to crop
- ■ Power at the pump (mains, phase, cable run) or alternatives
- ■ Photos and nameplate details of any pump to be reused

5. Filtration

Filtration protects everything downstream, and drip depends on it most. Unfiltered water blocks emitters and disrupts flow, which is one of the most common drip mistakes.

- **At the source or storage outlet,** so debris never enters the pipework. For rainwater, plan gutters, first-flush and filtration.
- **In the pump and filtration set.** On field sites with modest supplies, filtration and storage do more of the work than on a mains-fed glasshouse, so size the set for peak demand.
- **Where the crop is sensitive.** Hydroponic and recycled-water systems have little margin for error, so multi-stage filtration, backup dosing and layouts that let you isolate one zone are worth designing in.

Design for the person who cleans it. Filters belong where they are easy to reach. Clean elements properly rather than rinsing them, check seals, flush periodically, and clean when the pressure difference across the filter rises, more often with turbid or algae-prone water.

Checklist: filtration

- ■ Water quality test results, or a plan to get them
- ■ Is the source turbid, algae-prone or sediment-laden?
- ■ Where does filtration sit, and how is it cleaned?
- ■ Can I reach and isolate each filter?

6. Fertigation

Feeding through the irrigation line replaces a separate manual job, and many commercial tunnel growers end up doing it. If it is possible now or later, design for it from day one: the right injectors, the right filtration, and lines that dose evenly along the full run. Retrofitting is possible, but cleaner if planned.

Not every site needs mixing. If you only manage timing and zones, a dedicated valve controller keeps the system as simple as the job requires. Where you do feed, equipment scales from mixers for small and medium greenhouses to touchscreen units for larger operations, with dosing that follows water flow for bio-fertilisers. Ask that the unit is specified for your recipes and stock solutions, so it arrives configured rather than as a box of parts.

Check what is really delivered. A handheld instrument measuring EC, pH and temperature gives a quick verification. Ethernet-connected DGT systems report to DGT On the Go, which shows recipes, alarms and graphs on your phone, with SMS or email alerts when an EC, pH or flow alarm triggers.

Before winter, save programmes and recipes, then run clean water through injectors and dosing lines so no concentrated feed or acid sits in the equipment. Store EC and pH probes as the manufacturer directs.

Checklist: fertigation

- Do I feed through the line now, or might I later?
- How many stock solutions and recipes do I use?
- Valve control only, or mixing too?
- Do I want remote monitoring and alarms?

7. Control and automation

Automation ranges from simple timers to systems that respond to soil moisture sensors and weather data. The right level depends on your labour, crop and site. It need not be there from day one: a system can be designed so automation is added later without replacing pumps or pipework.

Walk the site at season end and list every job done by hand that should have been automatic: topping up, feeding, weather adjustments, a zone the timer kept missing. Most can be handed to a controller. Typical building blocks are:

- **Zone-based control,** with multi-zone controllers that adjust for conditions rather than running a fixed timer.
- **Sensors** for soil moisture, environment and system performance, feeding a central controller.
- **Decoder networks** on larger sites, where smart decoders report on performance and errors. Sitetech used a closed loop of this kind in a soft fruit redesign, with sensors feeding a controller that adjusts cycles.
- **Climate integration,** where DGT climate computers with built-in irrigation scheduling let temperature or humidity trigger a watering adjustment.

Keep it operable. Ask that controls are configured on site, tested, and that your operators are trained.

Checklist: control and automation

- ■ Jobs done by hand this season that should be automatic
- ■ How many zones, and do they need different schedules?
- ■ Which sensors, and should irrigation respond to climate data?
- ■ Who will operate it, and what training do they need?
- ■ Power and signal routes to every valve location

8. Installation

A good design is installed as drawn, planned around your growing calendar so groundwork disturbs crops as little as possible. A typical sequence:

1. Prepare the site and mark out the layout.
2. Set up the water supply and filtration.
3. Lay mainlines and sub-mainlines, with isolation valves, air release and drain points.
4. Lay laterals or drip lines with consistent spacing and alignment, no kinks, secured against movement.
5. Fit emitters, heads and fittings at the calculated positions.
6. Connect the pump, filtration and controller.
7. Flush the lines, then have a competent person pressure test them and check for leaks.

A system laid to fall, with a drain at every low point, is far easier to winterise safely than one that needs compressed air.

Checklist: installation

- ■ Who installs: the designer's own team, or a subcontractor?
- ■ Is the work planned around my crop calendar?
- ■ How will my existing supply keep running meanwhile?

9. Commissioning and handover

Commissioning proves the system works as designed. Expect the installer to run each zone, check pressure at the pump and at the furthest point, confirm spray pattern or drip delivery, confirm controllers and schedules, and show your team how to operate the system and what to check routinely.

Ask for the commissioning readings, pressure at the pump and at the end of each zone. They are the baseline every later check is compared against.

For sprinklers, a simple uniformity check: set identical containers in a grid across a zone, run it for a set time and compare the depths collected. Large differences point to blocked, worn or poorly spaced heads, or wind drift.

Checklist: handover

- Commissioning readings recorded and given to me
- Shown the controller, filters and isolation valves
- Written specification of what was installed
- Controller programmes and recipes saved

10. Servicing and seasonal care

Irrigation is rarely noticed until it fails, usually in the hottest week. Many failures start as small, visible problems: a tired seal, a clogged filter, a sticking valve, a drifted setting.

Spring start-up. Close drains, check isolation valves, refill slowly to avoid surges and trapped air, flush every line, clean filters, then walk each zone while it runs. Compare pressures with your commissioning baseline.

In season. A gradual pressure fall points to filter blockage, leaks or a failing pump, while a sudden change usually means a burst or stuck valve. Replace worn nozzles by zone to keep coverage even.

Autumn and winter. Frost does not need to be severe to do damage: water left in a pump casing, filter bowl, solenoid or pipe expands as it freezes, and the split stays hidden until spring. Isolate the pump and supply, drain from the highest point to the lowest, open every low-point drain and end cap, and protect pumps, filters, valves and controllers. Gravity drainage is the safer default. Compressed air carries a risk of damaging components and of injury, so use it only if the manufacturer's guidance allows, at a regulated pressure below the weakest component's rating, by someone competent to do so, and never on thin-wall drip tape unless the manufacturer allows it. Keep a drain-down log.

Autumn is also the quiet point in the calendar and the best time to plan and book design work before the spring rush. While this season's problems are fresh, decide whether each is a repair or a design question.

Checklist: servicing

- Who services the system, and when?
- Is the drain-down procedure written down, with a log?
- Are programmes and recipes backed up?
- Is this season's list of faults recorded?

11. The site-survey checklist

Bring this to the first visit, or send it ahead with photos.

Site and layout - [ ] Site plan or aerial image marking buildings, growing areas, water, power and existing tanks - [ ] Crops and areas now, planned changes, and how each is irrigated - [ ] Soil, slopes, drainage, wet areas, underground services and previous surveys - [ ] Access limits, neighbours, site designations, and when you need it working

Water - [ ] Sources: mains, borehole, river, reservoir, rainwater - [ ] Borehole details, licence paperwork, mains information, water test results - [ ] Measured flow and pressure at the source - [ ] Peak-season usage evidence: meter readings, pump run records, past bills

Existing equipment - [ ] Photos and nameplate details of pumps, filters, controllers and pipework - [ ] Controller programmes, fertigation equipment and recipes - [ ] Known faults: pressure drops, dry spots, abandoned zones, jobs done by hand

Power and control - [ ] Power at the pump, and cable or signal routes to valves - [ ] Who will run the system day to day

12. Questions to have answered before you accept a quote

1. Will you survey the site before quoting, and what will you measure?
2. Who does the hydraulic design, and will I see pipe routes, zones, pump selection and controls before ordering?
3. How were pump, storage and pipework sized together, and what pressure will I have at the furthest point?
4. Does the design depend on a source that needs a licence, and who checks?
5. How much reserve storage does it assume, and why?
6. What filtration is specified, where, and how is it cleaned?
7. Does the quotation list every component, and what is not included?
8. Can the project be phased, with room to expand?
9. Who installs, and is it planned around my crop calendar?
10. Will you give me commissioning readings and show my team how to operate the system?
11. Who services it, and what do winter service and spring recommissioning include?
12. If I add automation, fertigation or climate control later, will the design support it?

Talk to us about your site

Sitetech is a family-owned horticultural engineering business based in Chorley, Lancashire, working with growers across the whole of the UK and internationally. We treat design and installation as one process, so what is specified is what gets installed, commissioned and explained. As main UK distributor for DGT by Senmatic, we can also design climate, watering, feeding and lighting as one system.

Tell us what you grow, where the water comes from and what you want the system to do. If you have worked through this workbook, send us your answers and photos.

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