RESOURCES FOR COTTON GROWERS ON SIPHONLESS LAYOUT DESIGNS, IMPLEMENTATION AND AUTOMATED MANAGEMENT USING SMART IRRIGATION TECHNOLOGIES

IMAGE: GRANT OSWALD

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Siphonless system development

Once a siphonless layout has been designed, successful siphonless development depends on careful construction and commissioning. This factsheet outlines critical practices and checkpoints for each stage of system development.

This factsheet is part of the *Siphonless Irrigation Factsheet Series*. For background on siphonless systems and their benefits, see *Factsheet 1: Introducing Siphonless Systems*. For a detailed description of siphonless system types, see *Factsheet 2: Types of Siphonless Systems*. For planning and design guidance, see *Factsheet 3: Siphonless System Planning and Design Considerations*. See the *Case study on Tailwater Backup and Inlet spacing* for worked example of design impact.

FARM SURVEY AND DESIGN DEVELOPMENT

- A detailed survey using RTK GPS is required to achieve the accuracy necessary for irrigation design. Survey data must include existing supply water levels and locations, tailwater outlets, and recycling system elevations.
- The designer should process survey data to

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Figure 14: Designers should attend first irrigation to assist the grower with operating the system in the correct manner. Once the siphonless system performs consistently and manual management is well understood, smart irrigation technologies can offer the next step in efficiency gains. See *Smart Irrigation for Siphonless Systems factsheet series* for more.

create detailed contour plans, then model land grading requirements using engineering programs to reveal cut and fill volumes and provide accurate cost estimates.

» A preliminary plan showing proposed layout, cut and fill depths, and budget should be reviewed between designer and grower before committing to detailed design. If required, follow up with visits to other farms to confirm understanding of how the layout functions.

CONSTRUCTION MANAGEMENT

Contractor selection

Select contractors who have relevant experience and have a positive attitude to siphonless systems.

Timing

» Avoid machinery traffic on wet or very dry soil to minimise compaction and structural damage. Ideal to grow a legume, or cereal crop in the field after land grading, to restore the soil condition.

GPS setup

» GPS control files for laser grading equipment must be created from the finalized design and verified onsite before commencing earthworks. Ensure the operator has set up the GPS system so that the new design is correctly located relative to existing infrastructure.

Cut and fill area management

» In areas of deep cuts, the topsoil should be stripped and stockpiled, then these areas overcut by 200–250mm before replacing the topsoil. Ensure adequate ripping of cut areas to minimise later lifting of surfaces. Compact fill areas to minimise subsidence which will cause ponding and waterlogging.

SYSTEM VALIDATION

Construction verification

» Survey completed earthworks to verify allowable tolerances before installing infrastructure.

» Pegging of pipe and structure locations must be precise, including setting correct invert and sill levels. Confirm infrastructure is sized as specified and automation compatibility if planned.

First irrigation

» The designer should attend first irrigation to assist the grower with operating the system in the correct manner.

Regrading

» Monitor the irrigation events to assess the potential need to re-level the sill and areas that have subsided or risen.

CONCLUSION

A well-constructed and commissioned siphonless system is the foundation for efficient cotton irrigation. Once your system is operational and irrigation management is well understood, smart irrigation technologies can offer further efficiency gains. See the *Smart Irrigation for Siphonless Systems* factsheet series.

Footnotes

[1] Small PTBs still require two-meter rotobucks. Whilst offering labour saving benefits, they retain most similarities to manual hand siphon systems and therefore are excluded from general siphonless system comparisons in this guide.

[2] Siphonless irrigation guide. Smarter Irrigation for Profit, 2019.

[3] Grower Case Study 'Norwood' Moree. CottonInfo, 2024.

[4] Siphonless irrigation guide. Smarter Irrigation for Profit, 2019.

[5] Siphonless irrigation guide. Smarter Irrigation for Profit, 2019.

[6] Siphonless irrigation guide. Smarter Irrigation for Profit, 2019.

[7] Irrigation systems, designs and scheduling options. GVIA. 2022.

[8] Grower Case Study 'Norwood' Moree. CottonInfo, 2024.

[9] Bankless channels- Bullamon Plains. More Profit Per Drop. 2011.

[10] WATERpak a guide for irrigation management in cotton and grain farming systems. CRDC. 2012.

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GLOSSARY

Naming conventions differ between regions and have changed as systems have evolved. Where multiple terms exist, bold text indicates terminology used within this document.

API (Application Programming Interface): A set of rules and protocols that allows different software applications to communicate with each other. In smart irrigation, APIs enable sensors from different manufacturers to share data with control platforms.

Automated Irrigation: Systems where the decisions about when to open/close inlets/ outlets or start/stop pumps are made automatically by the supervisory system based on sensor data and programmed rules, without requiring human intervention for each action.

Bay: A section of a down the slope field that is separated by banks running from supply end to tail drain.

Basin: A section of a field where there is no or minimal slope along the furrow, that is separated by banks running from end to end.

Bankless Channel/bankless head ditch: Used in GL Bays & Basin systems. A below field height levelled area that is filled prior to water entering furrows. It acts as the supply and drain. Drainage is through a check structure into the next stepped bay or basin.

Bankless Side Channel: Used in Rollover Bankless. A below field height channel that runs in the same direction as the furrow and supplies water to a bankless channel at each end of the furrow.

Bankless Check: Drop board, rubber door or gated pipe that controls the passage of supply water from bay to bay – or basin to basin.

Command: An instruction sent from the supervisory system or user interface to a controller, directing it to perform an action (e.g., open outlet, close valve, start pump).

Communication Network: The connectivity layer that transmits data and commands between field devices (controllers & sensors) and the supervisory system. May use cellular, LoRaWAN, radio, or Wi-Fi.

Controller: A device that opens and closes irrigation infrastructure (inlets, outlets, valves) based on commands from the supervisory system or direct user input. May include motor/actuator mechanisms and control electronics.

Cross Fall: lateral slope across the field (as opposed to down the slope of the furrow).

Dispersion Pond/ distribution basin / distribution bay/ dispersion basin/ pontoon area: Used in PTB systems. Below field height levelled area between head ditch and furrows that is filled prior to water entering furrows. This is only a supply and is at the upper end of the field.

Gateway: A device that receives data from field sensors or controllers using one communication protocol and translates it for transmission to the supervisory system using another protocol. Common in LoRaWAN and radio networks.

GL Bays: A siphonless system consisting of terraced bays stepping down the landscape with furrows running perpendicular to the natural slope. Water is supplied via bankless channels, with tailwater reused between adjacent bays.

Handshake: A communication protocol where the receiving device confirms it has received and executed a command. Provides verification that actions have been completed successfully.

Head Ditch: The main supply channel for the field, which enables supply via manual hand siphons, small pipe through bank or large pipe through bank. This controls water head height.

Level Basin/ flat bays, flat flat, beds in bays, bankless channel: A siphonless basin system with zero or minimal slope (typically flat or 0.01% down slope) along furrow length. Water enters and drains through bankless channels at each end of the furrows. Field is divided into terraced basins stepping down the landscape.

LoRaWAN (Long Range Wide Area Network): A low-power, long-range wireless communication protocol designed for IoT devices. Requires a LoRa gateway on the farm and is well-suited for large farms with many distributed sensors and controllers.

Offtake: Primary point of delivery from the irrigation scheme/river.

Outlet: An overarching term for a structure used in irrigation systems to control the flow of water. Includes inlets and check structures.

Pipe through Bank (PTB)/ Large PTB, Pontoon: A siphonless system where large diameter gated pipes (250-750mm) are installed through the head ditch bank to deliver water to a dispersion pond. Water then flows simultaneously into multiple furrows (typically 12-96 furrows per pipe). Field slopes down to taildrain.

Platform: The software system (web-based or app-based) that provides the user interface for monitoring and controlling smart irrigation equipment. May include data visualization, scheduling tools, and alert management.

Protocol: A set of rules defining how data is transmitted between devices in a communication network. Different protocols (e.g., LoRaWAN, Modbus, MQTT) have different characteristics for range, power consumption, and data capacity.

Radio (RF): Short-range wireless communication between nearby devices using radio frequency signals. Typically requires line-of-sight and may use mesh networks where devices relay signals to extend range.

Remote Irrigation Control: Irrigation systems where human operators make decisions about when to irrigate and manually trigger actions (open/close outlets, start/stop pumps) through a remote interface (app or web platform), without travelling to the field. Differs from automation where the system makes decisions.

Repeater: A device that receives and retransmits signals to extend the communication range of a wireless network, particularly important for large farms or areas with terrain obstacles.

Rollover / Rollover Bankless: A siphonless basin system where furrows follow the natural slope direction (allowing machinery to "rollover" from one basin to the next). Requires very flat terrain (<0.04% slope). Uses bankless side channel and bankless channels for water supply and drainage.

Sensor: A device that measures physical parameters (water height, soil moisture, weather conditions, flow rate) and transmits data to the supervisory system to inform irrigation decisions.

Sill: The point in the bay where the field slope changes to a negative slope.

Siphonless Irrigation: Surface irrigation systems that deliver water at high flow rates from an inlet to a below-field-level area where water spreads evenly before entering all furrows simultaneously, eliminating the need for hand-placed siphons and 2-meter rotobucks.

Smart Irrigation: An umbrella term for advanced irrigation technologies that use real-time data and automation to optimise irrigation management. Includes sensing/monitoring, remote control, and automated irrigation systems.

Small Pipe Through the Bank (Small PTB): A system using permanent 75-90mm pipes installed through the head ditch at consistent levels. Still requires 2m rotobucks. Variations include stepped set, double head ditch, and smart siphon configurations. See Chapter 1, Section 4 for detailed descriptions

Supervisory System: The central control or decision-making system that processes sensor data, interprets field conditions, and triggers controller actions (opening or closing infrastructure).

Supply Channel: A channel that carries water throughout the farm to supply the head ditch or fields.

Supply Inlet: a structure that allows water to enter the system, usually from the supply channel

Tail drain: Tail drains remove run-off from the field created by both irrigation and rainfall events.

Tail drain Checks: Drop board, rubber door or gated pipe that controls the passage of tailwater from bay to bay.

Tail drain Outlet: Drop structure and pipe that passes the tailwater to the recycling system.

Tailwater Backup (TWB): The slope at the tail drain end of the field is reduced to allow tailwater to back up slower furrows. This backed-up water is then drained and reused in the subsequent bay.

Terraced Basin: A basin system configuration where basins step down the landscape with minimum 15cm vertical drop between each basin level. Used in both Level Basin and Rollover systems.

Time-based Controller: A controller that operates on pre-programmed time schedules to open/close infrastructure or start/stop pumps. May lack sensor feedback beyond basic fail-safe protection.

User Interface: The platform (local buttons/screen, Bluetooth connection, mobile app, or web portal) where operators monitor system status, view data, and control irrigation equipment manually or remotely.

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