

SIPHONLESS LAYOUTS FACTSHEET SERIES #2

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



IMAGE: GRANT OSWALD



DEVELOPED BY SYNTIRO
AGRICULTURAL SERVICES PTY LTD

Types of Siphonless Systems

Siphonless irrigation systems have evolved as cotton growers adapt irrigation designs, layouts and management to improve productivity and resource efficiency. As siphonless systems have evolved, naming conventions and terminology can vary between districts and designers. This factsheet describes and characterises the main siphonless system types to clarify terminology and help growers understand how each system works, where it is most suitable, and its key advantages and disadvantages. There is no 'superior' system, the right system depends on your specific slope, soils, available flow, and operational priorities.

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 planning and design guidance once a system type has been identified, 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.

Siphonless systems are categorised by slope as the overarching characteristic:



Figure 3: Pipe through the Bank is an example of a siphonless layout that has evolved as cotton growers adapt layouts to improve productivity and resource efficiency.

Down the slope systems – water enters the furrow and flows down the slope to a tail drain.

- » Small Pipe through the Bank (SPTB)
- » Pipe Through the Bank (PTB)
- » Pipes with Tailwater Backup
- » GL Bays

Basin systems – flat or near-level basins are filled before draining into subsequent basin.

- » Level Basin
- » Rollover Basin



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DOWN THE SLOPE SYSTEMS

The fundamental field layout and landscape slope is generally retained in 'Down the Slope' systems, minimising earth works and costs. In simple systems, tailwater drains to the recycling system. In other variations, tailwater is retained in the tail drain to back up slower furrows, then drained and reused in subsequent bay.

AVOIDING TROUBLE:

Level sill level height for siphonless systems

The sill is the point in the field which the field slope changes to a negative slope. Sills are typically 20-50m long and the length determined by the designer's preference.

A level sill height across the whole bay is important to ensure even entry of water into the furrows to maintain uniformity.

AVOIDING TROUBLE:

Erosion potential and furrow length

Down the slope siphonless systems deliver high flow rates into each furrow, which increases the risk of erosion on steeper slopes. These systems are generally not suitable for slopes greater than 0.200%.

To reduce erosion risk, the recommended furrow length should decrease as the slope increases. This is consistent with minimising stormwater runoff erosion on a siphon field.

It is also important to ensure the irrigation runtime aligns with the time required to achieve optimal soil profile refill, as discussed in WATERpak Chapter 5.3⁹. Further details on irrigation monitoring technologies to assist with irrigation run times are described in the [Irrigation Tools and Technologies](#) resource.

Layout Name		System type	Slope	Tailwater	Water enters furrow via	Irrigation Unit
Traditional Overbank Siphons		Manual hand siphons	Down the slope	Recirculated tailwater	2m rotobucks	Single or dual furrow set
Pipe Through Bank (PTB)	Small PTB	Stepped Set small PTB				
		Double head ditch small PTB				
		Smart Siphons				
PTB	PTB					
	Pipes with Tailwater backup					
Siphonless		Basin	Tailwater backup + recirculation	Bankless channel	Multi furrows set	
GL Bays					Bays	
Level Basin					Terraced Basin	
Rollover Basin				Bankless channel after side channel		

Table 2: Characteristics of surface irrigation systems. Note – When we refer to 'PTB systems' in this document we are only referring to PTB and Pipes with tailwater backup (not small PTBs).

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SMALL PIPE THROUGH THE BANK (SPTB)

Small pipe through the bank (SPTB) systems do not require siphons to be manually started by hand. Like all siphonless systems, they can reduce irrigation labour requirements and have the potential to be automated or managed remotely. They offer improved flow uniformity compared to manual hand siphons as flow rate responds evenly to changes in head height. However, SPTB still require two-meter rotobucks, so do not improve machinery efficiency.

Other names: Permanent pipe system, double head ditch PTB, smart siphons.

Characteristics: Permanent 75–90 mm pipes are installed through the head ditch. Each pipe is placed at a consistent level to ensure even flow rates pass through the pipes for specific head heights. The three types of small PTBs still require rotobucks spaced every 2 metres:

» **Stepped Set Small PTB:** Where there is substantial slope along a head ditch, it may be

Like all siphonless systems, they can reduce irrigation labour requirements and have the potential to be automated or managed remotely.

possible to step the head ditch pad down at set distances. A check structure is placed at the step so that the water level can be raised for the water to run through the SPTB's. Water fills the rotobuck area before running down the furrow. When the water has reached the tail drain, the check structure in the head ditch is opened so that the supply water builds up in the next section of head ditch, before running through its pipes and into the furrows.

» **Double head ditch Small PTB:** At the upper end of the field, three head ditch banks are formed

Benefit compared to Siphon System	SPTB	PTB	Pipes with TWB	GL Bays	Level Basins
Removed hand siphons	Yes	Yes	Yes	Yes	Yes
Removed rotobucks	No	Yes	Yes	Yes	Yes
Tailwater Percentage	25%	50%	15%	10%	10%
Silt change	No change	+100%	-70%	-70%	-80%
Trash in Tailwater change	No change	No change	-50%	-50%	-50%
Irrigation runtime reduction from a 12 hour set	0 hrs	4 hrs	6 hrs	6 hrs	Variable to suit subbing requirement
Irrigation labour change	-80%	-80%	-80%	-80%	-80%
Potential water logging risk	No change	No change	No change	No Change	More risk
Machinery efficiency improvement	No change	+20%	+20%	+30%	+20%
Tractors pass through multiple fields	No change	No change	No change	Yes	Yes
Water use efficiency gain	No change	No change	+10%	+10%	+10%
Green Area	No Change	No Change	-5%	-5%	-10%
Remote control of inlets/outlets	Yes	Yes	Yes	Yes	Yes
Construction Cost	\$	\$	\$\$	\$\$	\$\$\$\$

Figure 4: Expected changes when converting a Siphon system to the various Siphonless options. This information has been compiled from feedback given to designers who have worked with growers on their conversion.

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with a grader. This creates two head ditches. Water is released from the farm supply channel into the outer head ditch. At equal distances along the outer head ditch, a gated pipe or rubber door is installed to pass water into the second head ditch that has small pipes through the bank installed in the bank closest to the field. This second head ditch is split into sections by the placement of an earth block halfway between each rubber door. Water rises in the second head ditch and passes through the small pipes. The rubber door can be automated.

- » **Smart Siphon:** small PTB's are fitted with rotating elbows on the head ditch side. Up to 150 elbows are connected to a single common cable that is coupled to a hand winch. To start the irrigation, the winch is wound one way so that the elbows rotate into the water ~~and commence to flow.~~ To stop the irrigation the winch is wound in the opposite direction to raise the elbow out of the water. Controllers can be fitted to the winches to enable remote control.



Figure 5: Smart Siphons are fitted with rotating elbows and up to 150 are connected to a common cable that is coupled to a hand winch that can be automated. Photo credit: Lou Gall.

All tailwater is collected and recycled through the farm's pumping system for reuse, similar to manual hand siphon layouts.

Waterflow of Small PTB:

Water flows down furrows following the natural field slope and exits through the tail drain. All tailwater is collected and recycled through the farm's pumping system for reuse, similar to manual hand siphon layouts.

Most suitable conditions

- » Fields that are too steep to convert to other siphonless systems
- » Soils without severe infiltration restrictions

Advantages

- » No manual hand siphons & can be automated.
- » Limited earth works, thus low conversion costs.

Disadvantages

- » Still require 2m rotobucks, so there is no improvement in machinery efficiency.
- » Debris and fish can block pipes (this furrow doesn't get watered until the pipe is noticed and unblocked).

AVOIDING TROUBLE:

Set pipe levels correctly

The permanent pipes need to be installed rising up into the field from the head ditch to avoid air pockets forming that will affect the flowrate.

The discharge end needs to be above the water level in the rotobuck area, with all pipe ends set at the same level.

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PIPE THROUGH THE BANK (PTB)

Other names: Pontoon, Large Pipe through the Bank

Characteristics: Large diameter gated pipes are installed through the head ditch bank. Pipe diameters typically range from 250mm (supplying 12 furrows) to 750mm (supplying up to 96 furrows). Some layouts use a rubber weir door instead of a pipe. A dispersion pond (excavated rotobuck area) spreads water evenly before it enters furrows. A large rotobuck is placed halfway between each pipe outlet.

Common dimensions: An inlet every 12-120 m along the top of the field. A furrow length of 800-1000m.

Waterflow: Water flows through the head ditch pipe to the dispersion pond. Once the dispersion pond is full, water pushes across the 2m long flat sill before flowing down furrows following the natural field slope. In some layouts, there is no flat section and water flows straight down the field slope. All tailwater is collected and recycled through the farm's pumping system for reuse (similar to siphon layouts).

Most suitable conditions

- » Soils without severe infiltration restrictions that are too steep to have tailwater backup.

Advantages

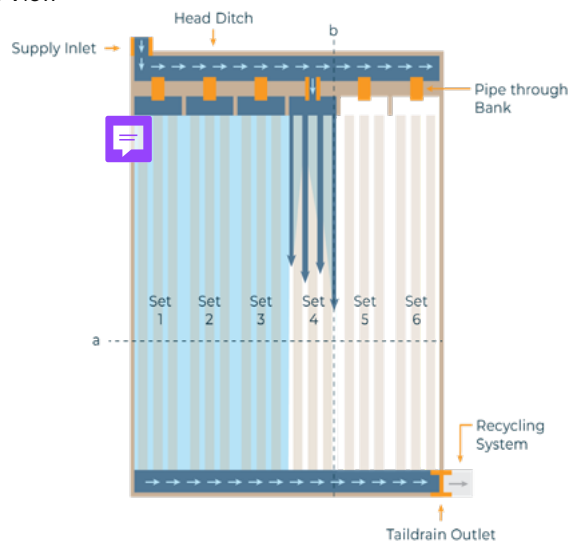
- » Minimal earthworks and topsoil movement converting from siphon system.
- » Lower capital costs than other siphonless options
- » No 2m rotobucks – now larger rotobuck spaced > 12 furrows apart.

Disadvantages

- » The cross fall along the head ditch end of the field must be minimal to avoid variation in the flow rate down each furrow in a single bay.
- » The evenness of the water advance is less consistent than that of siphons. The irrigation must continue until the slowest row gets through, increasing the tailwater volume relative to siphons.
- » Increased siltation and erosion due to greater flow rate into each furrow compared to siphon systems and the extended runtime needed to fully irrigate the slow furrows.
- » Less water-efficient than systems that back up and reuse tailwater between bays/basins.

Pipe through the Bank (PTB)

Plan View



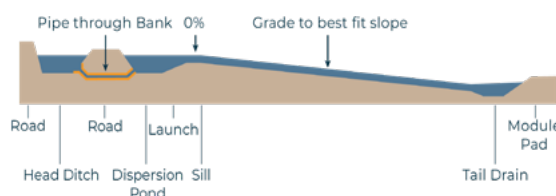
(a) Pipe through the Bank (PTB)

Cross Section



(b) Pipe through the Bank (PTB)

Longitudinal Cross Section



AVOIDING TROUBLE:

Dispersion Pond Cross Section for PTB & Pipes with TWB.

The below ground dispersion pond must be deep enough and wide enough to ensure the water surface level at the outer edges is only millimetres lower than the water surface level directly in front of the inlet. Otherwise, the furrows in front of the inlet will run quickly, and the ones at the ends will be much slower. Work with a designer to ensure adequate dimensions.

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PIPES WITH TAILWATER BACKUP

Other names: Siphonless with tailwater backup

Characteristics: Pipes with Tailwater Backup has the same design at the top of the field as PTB system, however, addresses the high tailwater losses by incorporating tailwater reuse into the design. The slope of the field at the tail drain end is reduced, and cross-fall removed, so that water can be backed up a reasonable distance in all rows.

The rotobuck bank, which normally only extends from the head ditch bank to the start of the furrow, is extended the full furrow length and across the tail drain, dividing the field into bays. This extended rotobuck is called a 'Check Bank'. A rubber door check structure in the bank alignment at the tail drain controls water release between bays.

Common dimensions: An inlet every 144-288 m along the top of the field. A furrow length of 800-1200m.

Water flow: The water flow is the same as PTB until water reaches the tail drain. The reduced slope at the tail drain end allows tailwater to back up slower furrows. Once enough water is released from the head ditch to water the bay, the PTB into Bay 1 is closed and the PTB into the next bay is opened. Residual water in the furrows, continues to flow towards the tail drain and tailwater continues to back up the dry furrows. When the water coming down and the water backing up has met, and held for the optimal time, the tail drain check is opened into Bay 2. Water drains off the backup zone of Bay 1 and starts to fill the backup zone of Bay 2 while new water is running down from the head ditch. This process continues bay-by-bay across the field.

Most suitable conditions

- » Soils without severe infiltration restrictions
- » Where slope of the tail drain end of the furrow can be reduced to enable tailwater backup

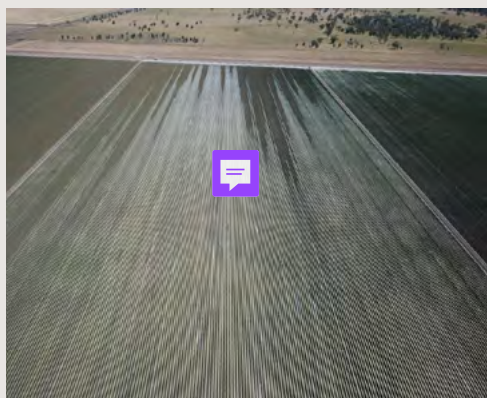
Advantages of Tailwater Backup

Future developments should consider incorporating Tailwater Backup in the design where possible (i.e. appropriate slope) due to improved water use efficiency and other benefits. Down the Slope and Level Basin systems that have tailwater back up have many advantages over a siphon system.

- » Reduced tailwater losses through continuous re-use through bays
- » Application time is reduced due to the high flowrate and the reuse of tailwater. The tailwater runoff reduction accelerates the speed of the irrigation event.

- » Silt buildup in the tailwater recycling system is reduced. Silt build-up in a siphon system and PTB system is a result of scouring in the last 50m of the furrow as the water accelerates down the batter into the tail drain.
- » Trash accumulation in the tailwater recycling system is reduced due to the reduced tailwater volume.

See the Siphonless Irrigation *Series Case study on Tailwater Backup and Inlet spacing* for a worked example on a Pipe through the Bank layout.



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Figure 6: (Left) Pipe through the bank. Note the lack of consistent waterfront. The irrigation must continue until the slowest row gets through, increasing the tailwater volume relative to siphons. (Right) Pipe through the Bank layout delivers high volumes of water, often requiring modifications to inlets to prevent washouts.

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Advantages

- » No 2m rotobucks– now a rotobuck spaced far enough apart to not impede machinery.
- » Reduced tailwater losses compared to siphon or PTB through continuous reuse between bays.
- » Silt buildup in the tailwater recycling system is reduced.
- » Trash accumulation in the tailwater recycling system is reduced.
- » Application time is reduced due to the high flowrate and the reuse of tailwater.
- » Potential water logging reduction from reducing the application time.

Disadvantages

- » More extensive earthworks and development costs than PTB to flatten the tail drain area and install check banks.
- » Increased complexity to PTB – the increased number of structures adds operational complexity and frequency of visits to the field to manage or control remotely for each irrigation event.
- » **Reduced Green Area:** The placement of check banks through the field for each bay reduces the crop area.

AVOIDING TROUBLE:

Feeding too many furrows & flow rate variation

When too many furrows are supplied by each inlet, individual furrow flow rate is reduced. Reducing the flow below 0.4 ML/day/furrow will result in a rapid deterioration of the evenness of the water advance in the furrows. Wheel tracks will always carry more flow, while the furrow on the outside of the implement will carry the least. This is due to the level of the furrow bottom in the wheel track being lower because of compaction, and the level of the furrow bottom in the outside row being high due to flex in the implements. Another reason for reduced flow in the outside row is imperfect control of the implement alignment creating a narrow furrow on one side and a wide furrow on the other. With several things influencing the level of each furrow, it can be possible that some furrows may not even run any water.

See example of the implications for whole farm water management in the case study



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Figure 7: Pipes with Tailwater Backup.
Note top of image is tailwater backing up.

GL BAYS

Characteristics: GL Bays are a series of terraced bays that step down the natural slope of the landscape, with a vertical step (min 0.2m) between bays. The furrow direction is 90 degrees to the slope of the landscape (perpendicular to the furrow direction used in siphons and PTB). The natural cross fall is used to create a gentler gradient for the water to flow down furrows, and for tail water to back up.

Bays are connected and irrigated by a bankless channel, with a taildrain at the other end of the field. Water is controlled between bays with a 'Bankless Check' structure in the bankless channel and a 'Taildrain Check' in the taildrain.

Common dimensions: 288 furrows x 800-1200m length. The last bay will have less furrows to reduce tail-water losses exiting to the recycling system.

Water flow: Water flows into the bankless channel of the first bay via a gated pipe from a farm supply channel. In the first bay, water rises and fills all furrows simultaneously. Water initially flows up the launch area to the 70-50m long flat 'sill' before flowing down the slope to the tail drain where the tail water can back up.

When irrigation of Bay 1 is complete, the bankless check is opened to allow water from the gated pipe to continue to pass through into Bay 2. The field level of Bay 2 is 20 cm lower than Bay 1, so that when the 'Bankless Check' into Bay 2 is opened and the water level rises enough to run into the furrows of Bay 2, the new water can continue to pass through

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Cotton Info



the 'Bankless Channel' of Bay 1 without being high enough to flow down the furrows of Bay 1.

When the water coming down and the water backing up has met, and ponded for the optimal time, the tail drain check is opened into Bay 2. Water drains off the backup zone of Bay 1 and starts to fill the backup zone of Bay 2 while new water is running down from the head ditch end. This process continues bay-by-bay through the field.

Most suitable conditions

- » Soils without severe infiltration restrictions
- » Adequate cross-slope for 90° furrow rotation
- » Where continuous tailwater reuse is a priority

Advantages

- » Improved machinery efficiency – tractors can pass through bankless channel into adjacent field bays for longer runs.
- » Fewer control structures than Pipes with Tailwater Backup—simpler operation to manage and remote control.
- » Reduced tailwater, silt and trash accumulation in the tailwater system.
- » Reduced application time and water logging as per Pipes with Tailwater Backup

Disadvantages

- » Requires adequate cross-fall.
- » More earthworks and therefore cost required compared to PTB systems.
- » Slightly reduced green area (~5%). XX
- » Bankless Check and Tail drain Check require opening at different times compared to Basin Systems

AVOIDING TROUBLE:

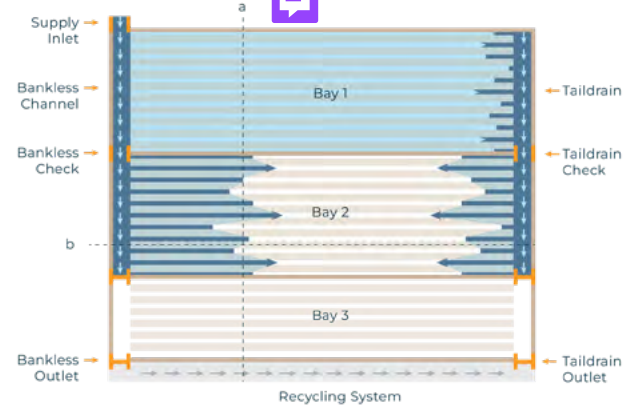
Bay Width

In bays wider than 240 metres, wind can raise the water level at one end of the bankless channel, leading to a significant increase in unevenness of water entry into the furrows and the water



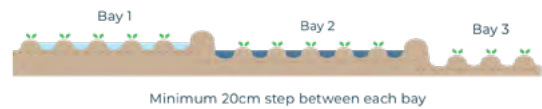
GL Bays

Plan View



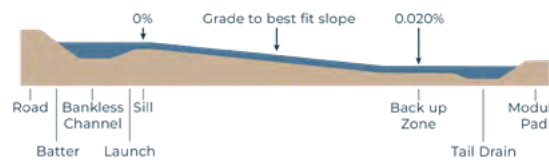
(a) GL Bays

Cross Section



(b) GL Bays

Longitudinal Cross Section



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Figure 8: GL Bays releasing tailwater.

BASIN SYSTEMS

Basin systems have zero (or very minimal) slope along the length of the furrow, which means each basin can pond and hold water before draining. There are two configurations of level basin systems outlined below, however, overall suitability, benefits and disadvantages generally remain the same.

Shared characteristics:

Basin systems are a series of terraced basins that step down the natural slope of a landscape, with a

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vertical step of at least 15cm between basins. They are typically flat with zero slope in either direction.

Some early designs had a minimal uphill slope of 0.01% (1:10000) to a peak in the middle of the length of the furrow. New designs are either flat or have a minimal downhill slope of 0.01% (1:10000) from the start of the furrow to the other end. This slope assists with the flow of irrigation water along the furrow, and the drainage of excess irrigation water and stormwater runoff from the furrow.

At each end of the furrows is a bankless channel. This looks like a large tail drain but acts as both a supply and drain. Raising the water level in the bankless channel forces water into the furrows and lowering the water level allows water to drain out of the furrows. The water level is controlled by check structures in the bankless channel between Basin 1 and Basin 2. To irrigate a basin, the check structures are closed. To drain a basin, the check structure is opened, with the water flowing into the bankless channel of the next basin.

Most suitable conditions

- » Soils that have a poor ability for the water to sub up to the surface of the bed.
- » Low infiltration soils where raising water up the sides of the furrows and holding until required profile refill is achieved is advantageous
- » Rice based systems

Advantages

- » Improved machinery efficiency – tractors can pass through bankless channels and tail drains into the adjacent bay of the next field and into the next bay of the same field in Rollover systems. This allows for longer machinery runs; however, this advantage is offset by the short row length of each basin (generally 400-450m).

BEST PRACTICE:

Zero grade or no slope along the length of the furrow, is only recommended for:

1. Rice systems
2. Where the water level in the furrow needs to rise up substantially to sub the top of the bed.
3. When the infiltration rate of the soil is slow and water needs to be held in the basin for an extended time.

In all other circumstances, a down slope of at least 0.01% along the length of the furrow is recommended to minimise waterlogging.

- » Very low tailwater losses through continuous reuse between bays
- » Deciding when irrigation of a bay is finished and the check should be opened into the next can be simpler than for down the slope systems. However, not so when bays are too big.

Disadvantages

- » Not suitable for fields with cross-fall in multiple directions, as it becomes too costly to level.
- » Significantly higher capital costs due to extensive earthworks required to create level terraces. A proportion of each basin typically requires re-topsoiling deep cuts.
- » Risk of waterlogging from slow drainage and ponding in low areas. Particularly when furrow lengths are longer than recommended.
- » Generally smaller basin dimensions due to furrow length limitation, which means roads and drains occupy a significant percentage of the total farm area.

AVOIDING TROUBLE:

Bankless Channel Sizing

The cross-sectional area of the bankless channel must be large enough to ensure there is very little gradient of the water surface along the length of the channel. If the channel is too narrow or shallow, lots of water will enter the first furrows, with much less flowing along to the furthest furrows. Overtopping of beds and waterlogging may occur in the first furrows while waiting for the water in the furrows on the other side to join up.

The bankless channel must have batters that machinery can pass through easily. The batter into the field needs to be very flat so that when tractors exit from the furrows through the bankless channel, the cultivating implement doesn't lift abruptly and leave a high spot in the furrow. This high spot will reduce the flow into that set of furrows, or may prevent water draining from the furrow.

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LEVEL BASIN

Other names: Flat Bays, Flat Flat, Bankless Channel, Beds in Bays

Characteristics:

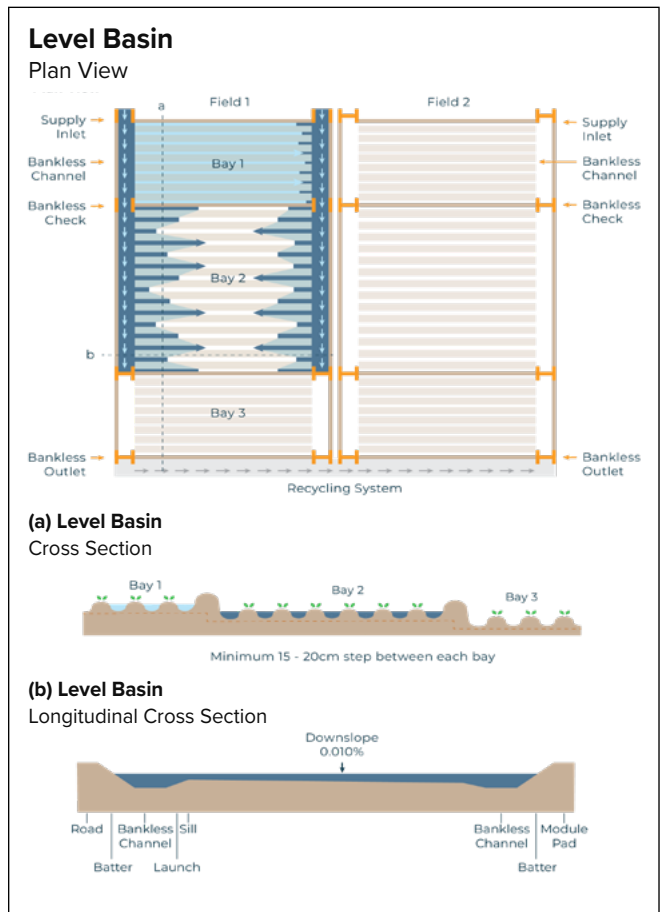
The furrow direction is 90 degrees to the slope of the landscape (perpendicular to the furrow direction used in siphons and LTPB). At each end of the furrows, a large tail drain is formed that acts both to supply water to the furrows and then to drain them. This drain is called a 'Bankless Channel'. Raising the water level in the bankless channel forces water into the furrows. While lowering the water level allows water to drain out of the furrows. The water level is controlled by a check structure in the bankless channel between Basins. To irrigate a basin, the check structure is closed. To drain a basin, the check structure is opened, with the water flowing into the bankless channel of the next basin.

The ideal furrow length is limited to 450m for basins with no slope along the furrow length.

Ideal furrow length is extended to 1,000m for basins with a down slope of 0.01% (1:10000) along the furrow.

Common dimensions: 450 furrows x 450m length. Basins are sized to account for total accumulated flow as supply water combines with drained tailwater from preceding basins. The first basin is smaller (typically 225 furrows x 450m) to achieve optimal fill rate with supply flow alone. Subsequent basins are larger (typically 450 furrows) as they receive both supply flow and tailwater drainage. The final bay will have a reduced number of furrows compared to the previous to reduce tailwater losses exiting to the recycling system.

Water flow: Water is delivered to the Bankless Channel at each end from the two gated pipes into



AVOIDING TROUBLE:
Furrow length for 'Level Basins'

In layouts where water backs up the furrows from the bankless channel and then drains back out to the bankless channel, the optimal distance of the back-up is 225m. If this basin has a bankless channel at each end, then the optimal furrow length is 450m. Extending the furrow length beyond this

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Figure 9: Level Basins micrater.

the field. The water level in the bankless channels rise, pushing the water into the furrows. The water flows along the furrow until it meets the water coming from the other end. Water is then held in the basin until optimal profile refill is achieved, and then the two check structures into Basin 2 are opened simultaneously. The furrows of Basin 1 drain back into the bankless channel and then flow with new water into Basin 2. Similarly to a GL design, the field level of Basin 2 is lower than Basin 1 so that while the bankless channel of Basin 1 is feeding Basin 2, water does not continue to enter the furrows of Basin 1. This process continues basin-by-basin through the field.

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ROLLOVER BASIN

Other names: Rollover bankless

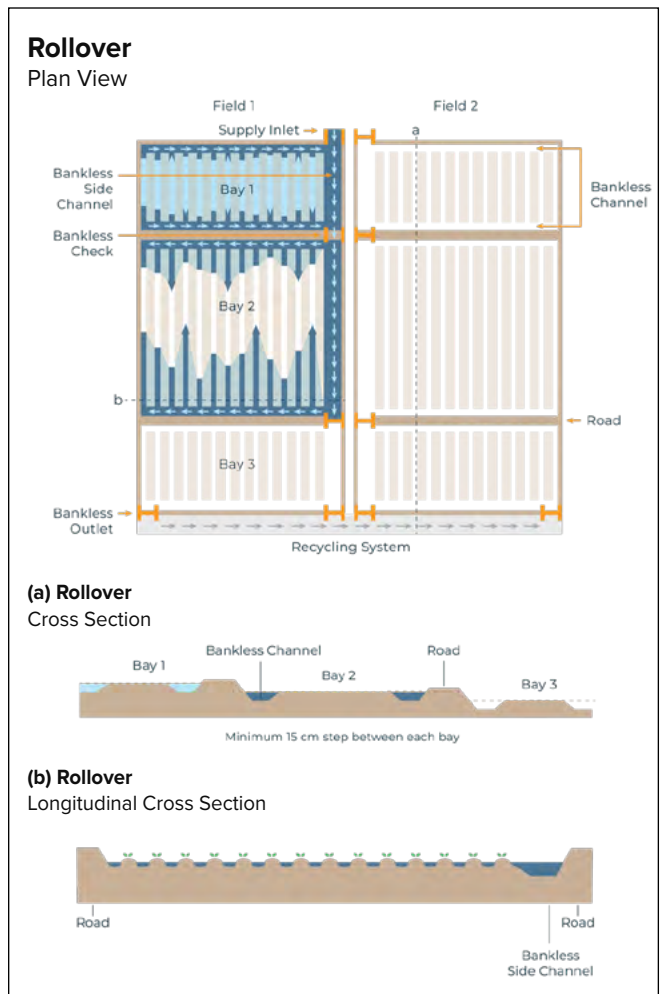
Characteristics: The key difference to Level Basins is that the furrow direction follows the slope of the landscape and machinery can 'rollover' the bankless channel into the next basin of the same field. The natural slope of the landscape must be less than 0.04% (1m in 2500m) for Rollover to be considered.

Common dimensions: 450 furrows x 450m length. First and last basin sizing considerations same as Level Basin.

Water Flow: A single gated pipe inlet to the field fills the bankless side channel that runs in the same direction as the furrow. This channel feeds into the bankless channels at either end of the furrows.

As the water level rises in the side channel, it starts to fill both bankless channels. As the water rises further, it pushes out into the furrows and meets in the middle of the bay as per Beds in Bays.

When Basin 1 has finished irrigating, the check of the bankless side channel is opened into Basin 2. The water drains from the furrows back to the bankless channels and joins the supply water in the side channel to start filling Basin 2. This process continues basin-by-basin through the field.



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Figure 11: In a Rollover Basin, the furrow direction follows the slope of the landscape and machinery can 'rollover' the bankless channel into the next basin of the same field. In this image the road is between two basins of the same field, with a bankless channel on both sides of the road. The bankless side channel connects the basins via a pipe under the road.

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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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CONTRIBUTORS:

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#2 | Types of Siphonless Systems



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.

#2 | Types of Siphonless Systems

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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 runoff 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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