



GLOBAL WATER SOLUTION TECHNOLOGIES

Capillary Drainage Technology

Removes 3-4 times more water

Drainage

Does not Block!

Drains Sooner

Drains Longer

Drains Better

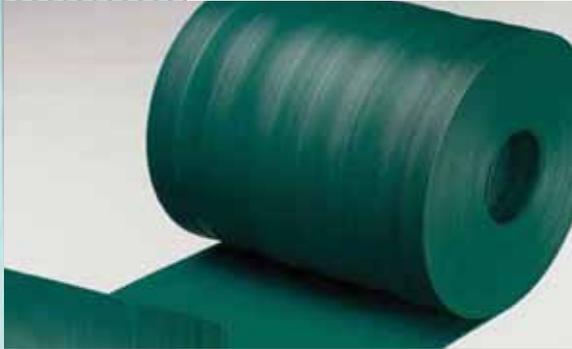
Installation Savings

Lifetime Savings

APPLICATION

Capiphon™ Drainage

Capiphon™ ("Smart Drain™" in the USA) is a siphonage and capillary drainage technology. It consists of a belt of 2 mm PVC, usually 10 or 20 cm wide, with omega-shaped grooves running down its length. In some situations, such as installation into embankments, Capiphon™ is wrapped around a PVC pipe and used in place of the belt.



Capiphon™ belt

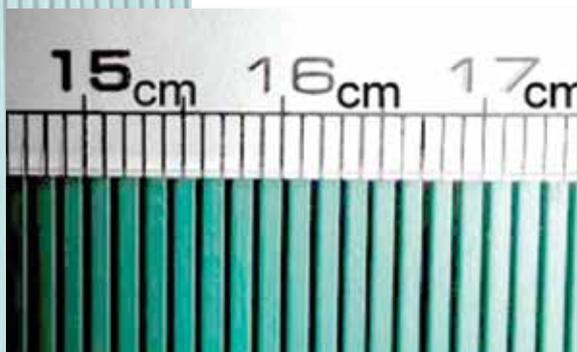


Capiphon™ pipe

Capiphon™ Technology

The grooves are omega shaped with an internal diameter of one millimetre. The opening to the grooves is approximately 0.3 mm.

Because Capiphon™ uses capillary action it is in dynamic equilibrium with the moisture in the soil. Water moves into the belt as soon as the soil reaches saturation, much earlier than when relying on gravity alone. For the same reason, water continues to flow for longer.



A close-up of the underside



Cross section (magnified)

The movement of the capillary straw within the grooves creates a negative pressure that sucks up water from the soil.



Does Capiphon™ require complicated or expensive installation?

NO



No need for a gravel transition layer.



No need for a geotextile fabric.



In fact, Capiphon™ needs to be in close contact with the soil so trenches can be **shallow** and **narrow**.



No need for a precisely graded trench because the siphon will operate even if there is a rise and fall along it.



No need for extra fittings. Simply cut a slot into the discharge pipe and insert the belt into it. Secure the two with a cable tie, and then run a bead of silicone sealant across the back of the belt.



Sealing the loose end of the belt with silicone helps to create the siphon.



If the site is particularly muddy, laying the belt on a thin layer of medium sand creates the optimum capillary conditions.



Then simply backfill the trench and roll. Replace turf if it has been cut prior to trenching.



Does Capiphon™ block like other drains?

NO

Scientific studies have shown that unlike every other drainage system, Capiphon™ does not block with either fine particles or algae. Particles smaller than the opening of the grooves (0.3mm) can enter the grooves but will easily pass out of the system. The grooves themselves do not block – if one or more soil particles lodge against a groove, water can enter either side of the particle.

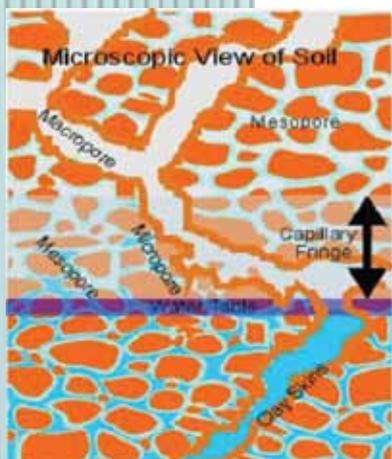
Capiphon™ is still draining successfully after 15 years in the ground.

Capiphon does not Clog

unlike all other known drainage systems

Capiphon Drainage™ can be used in place of any subsurface drainage system

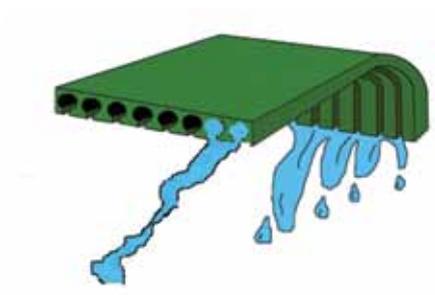
How does Capiphon™ work?



Water exists in a soil within the pores between the soil particles.

The openings of the grooves of the Capiphon™ belt are similar in size to the pores within the soil, and water moves into the grooves by capillary action or "wicking". The water is held within them as a capillary straw.

When the belt is below the water table, or when the belt is on a slope (usually 1-2%), the critical capillary head is exceeded and causes the capillary straws within the grooves to move down the belt.



The movement of the capillary straw within the grooves creates a negative pressure that sucks up water from the soil. This siphoning effect continues to drain the soil for as long as there is an effective capillary straw within the soil.

Capiphon™ literally sucks water up from the soil and siphons it off for disposal or storage, above ground or in the aquifer.



The movement of the capillary straw within the grooves creates a negative pressure that sucks up water from the soil.



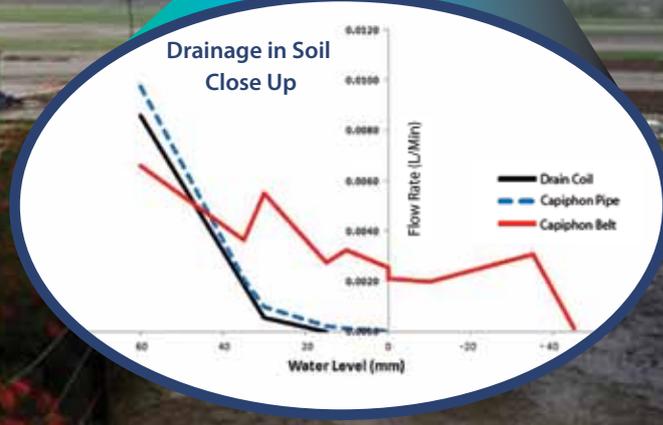
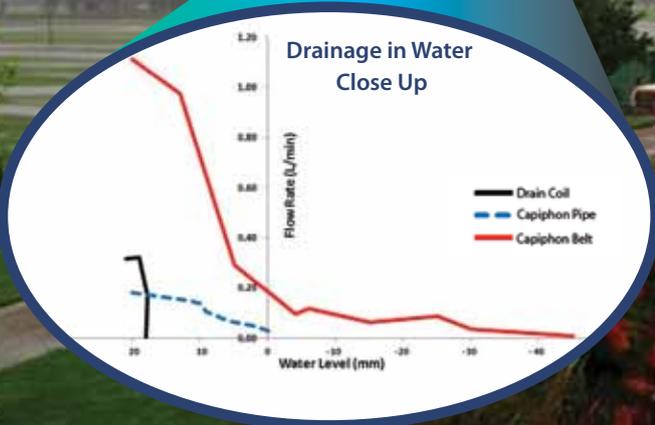
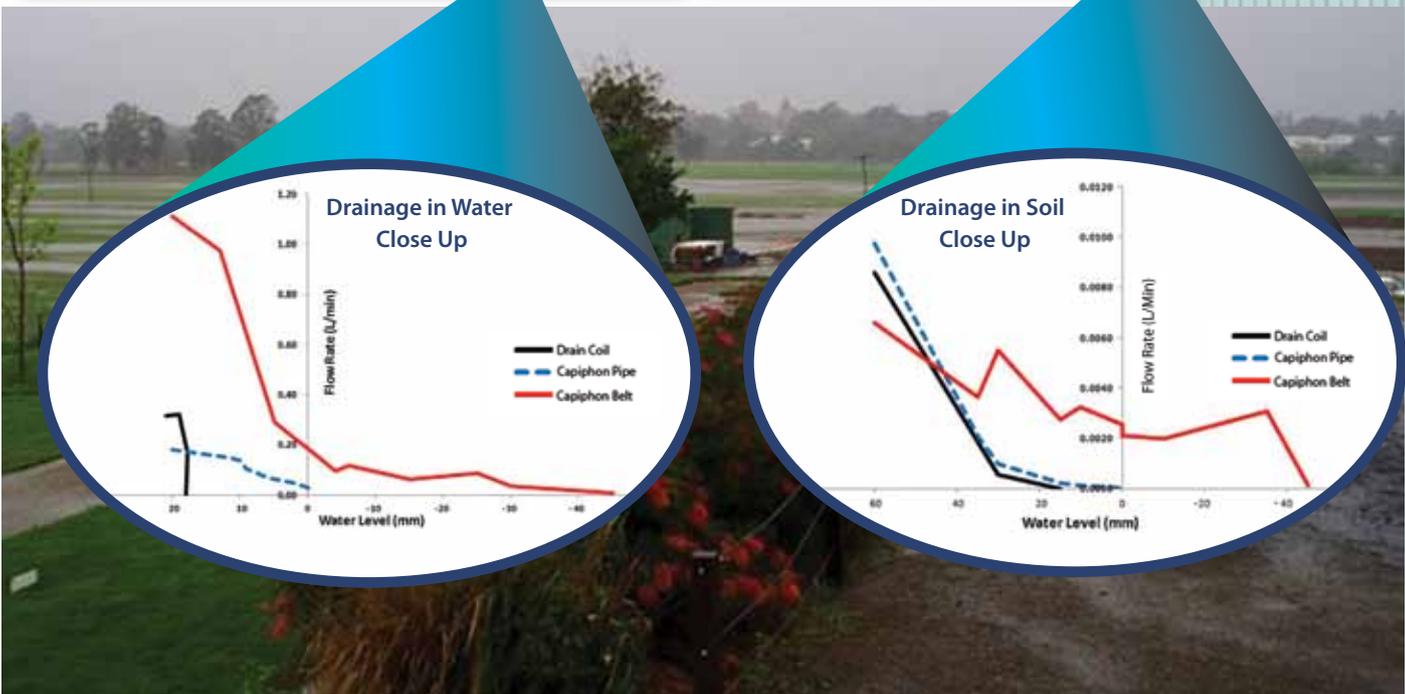
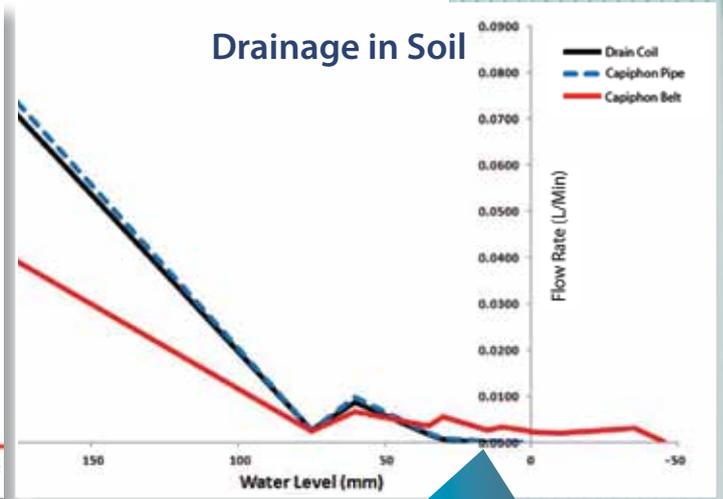
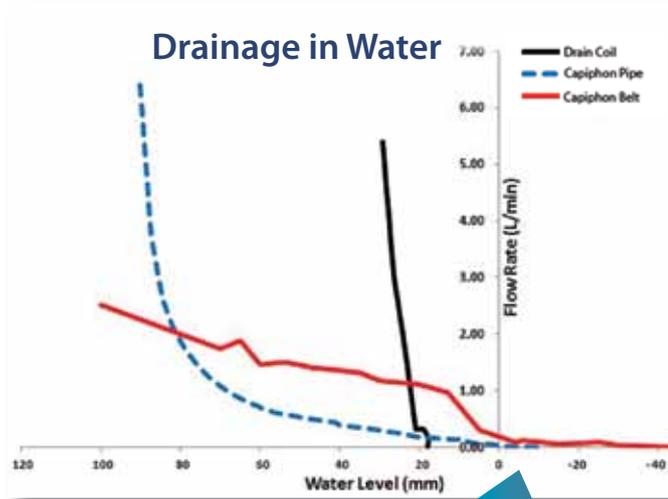
BETTER IN ALL RESPECTS

Controlled tests show that Capiphon™ continues to drain water from a water tank long after slotted pipe ceases, even draining below the level of the outlet (zero water level).

This effect is even more pronounced when in the soil. The soil, itself, is the limiting factor in flow rate. Capiphon™ works with the soil particles so that flow rates are higher than flow rates for slotted pipe, especially at lower head pressures.

Because Capiphon™ uses capillary action, it is in dynamic equilibrium with the moisture in the soil. Water moves into the belt as soon the soil reaches saturation, much earlier than when relying on gravity alone. For the same reason water continues to flow for longer. Other systems, relying solely on gravity, stop flowing when (or before) the water level reaches zero. Capiphon™ continues to draw water up against gravity due to the syphonic action.

How does
Capiphon™
perform?



Capiphon does not Clog

making it 30% more cost-effective over the life of any project

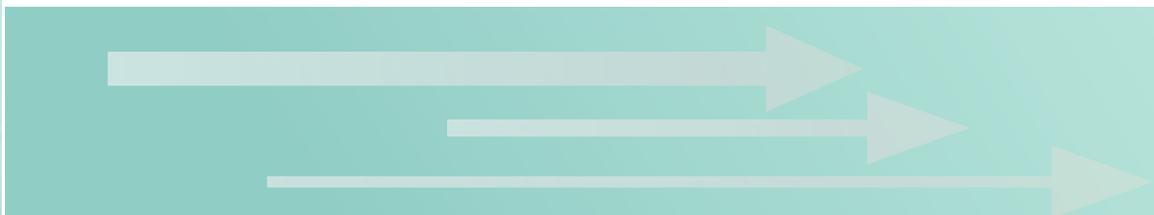
Capillary and Syphonic Power

Controlled tests show that Capiphon™ begins to flow sooner, flows for longer, and moves more water than other systems.

	Capiphon™ Belt	Slotted Pipe
Time to Commence Flow after flooding (Minutes)	9:6	61:5
Duration of Flow after 48.6 mm rain (Days)	15	3
Volume collected during rain totalling 48.6 mm (Litres)	10.2	3.2

The theoretical flow rate due to gravity alone can be calculated from the permeability of the soil and the belt area. Capillary and syphonic power increase the flow rate by more than **3 times that of gravity alone** in a sandy soil, and more than **30 times in clay soils!**

Soil Type & Alignment	Width of Belt (cm)	Belt area (cm ²)	Permeability of Soil (m/sec)	Theoretical flow rate (L/min)	Measured flow rate (L/min)	Efficiency Coefficient
Sand Belt Horizontal	20	440	1.18×10^{-4}	0.312	1.04 (H=20cm)	3.33
Clay Belt Horizontal	20	440	5.00×10^{-6}	0.013	0.45 (H=5cm)	34.6
Clay Belt Vertical	17	900	5.00×10^{-6}	0.027	1.80 (H=15cm)	66.6



Applications

General Drainage

Capiphon™ can be substituted for any drainage systems to provide better outcomes at less cost in virtually every situation. Freedom from blockage and simple installation means lower installation and lifetime costs. This playground was often unavailable for several days following rain. Capiphon™ was installed at **half the cost of conventional drainage**.



Sports Grounds

Capiphon™ drainage can be combined with a number of other elements, including carefully constructed engineered soils, to ensure year-round performance. A unique narrow (5 cm) trenching Capiphon™ system can be used to renovate sports fields and race tracks with minimal disturbance and down-time. The photo on the left shows a large, soft, deeper divot from the undrained section, while on the right the divot is smaller and dry.



Roof Top Gardens

The main problem with rooftop gardens is blocked drainage. There are many complex rooftop drainage systems on the market but none offers the simple, inexpensive, and effective solution that Capiphon™ does. Conventional systems rely on gravity alone requiring a significant depth of soil/medium. Capiphon™'s flat profile and capillary action is ideal for situations where shallow soil profiles are required for either weight or space restrictions. This example shows a car park roof protected by Capiphon™ drainage – no leakage.



Capiphon does not Clog

drains 3 to 4 times more volume than other systems

Landscaping

Capiphon™ can provide perfect drainage in challenging conditions such as shallow unfractured rock benches.



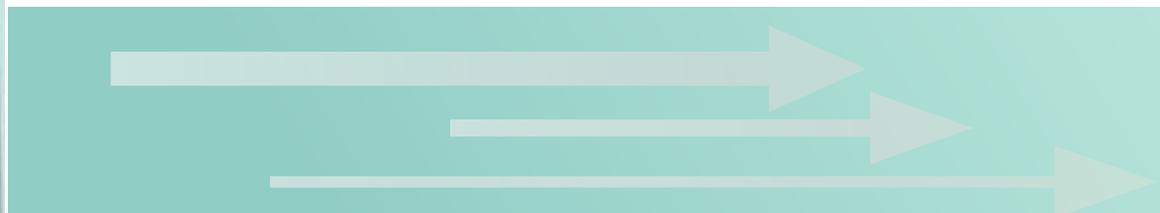
Agriculture

Two major problems in agriculture are water logging, that causes plants to suffer because roots are deprived of oxygen, and salinisation caused by a rising watertable bearing salt up into the root zone. Both of these effects can be reduced through effective Capiphon™ drainage.



Road and Pavement Construction

Capiphon™ can be installed underneath and/or directly on the basement sub-grade during construction. It can also be used to great effect to stabilise and repair existing roads or, as in the images of Chiang Kai-shek International Airport shown below, runways and other paved surfaces.



Mitigating Tunnel Seepage

Seepage is a perennial problem in tunnels, both from above and below. Capiphon™ pipe can be inserted into tunnel walls and ceilings to prevent water dripping from above, while Capiphon™ belt can be laid under the road pavement to stop it from rising.



Retaining Walls

Strips of Capiphon™ belt can be simply nailed to the rear face of a retaining wall and inserted into a discharge pipe in the usual way. In situ soil can be used to backfill. For existing retaining walls, Capiphon™ pipe can be inserted into horizontal shafts.



Railway Line Repair

Capiphon™ can be laid during construction of railway lines to ensure drainage of the sub-base, and also used to overcome situations where the constant movement of rolling stock creates a “pumping” action, bringing water from an insufficiently drained sub-base to the surface. Because of its ease and rapidity of installation, Capiphon™ can be retrofitted without the need to interrupt normal train schedules.



Capiphon does not Clog

keeps on protecting the environment, 24/7

Building Protection

Deep excavation for large buildings can break into the water table, leading to flooding in basements, as occurred under the Carrefour department store in Taipei.

Capiphon™ is laid on a thin bed of sand, covering it with cloth, and pouring the concrete base.



Capiphon™ can also be used in paved and garden areas around houses and apartment buildings to protect from rising damp



Capiphon™ drains best when the belt is in direct contact with the soil, obviating the need for a gravel transition layer.



The Capiphon™ belt is usually inserted into a collection pipe laid some 10 cm below the level of the belt to increase the capillary head.



Physical Characteristics

Material	PVC compound
Width	10 or 20cm ± 5%cm
Thickness	2 ±15% mm
Sale unit: roll	100 m
Packaging weight (per roll with card board box)	(55cm*55cm*25cm) 36 kg
Effective water inlet opening ratio	>20%
Flow rate (Under 20cm water head)	4±10% L/min
Compressive strength (40%)	>3 N/mm ²
Tensile strength (Longitudinal/Transversal)	> 6.0/2.0 N/mm ²
Shearing strength (Longitudinal/Transversal)	> 30/15 N/mm
Acid resistance	Excellent
Alkali resistance	Excellent
Root invasion resistance	Excellent
Algal/fungal resistance	Excellent

Literature List

All information can be found on the Caphiphon website:

www.globalwatersolution.com.au

Fenn, G.R. (2012b), 'Drainage Characteristics of Capiphon™ Belt and Capiphon™ Pipe - Some comparisons with slotted pipe with sock', International Commission on Drainage & Irrigation. 63rd IEC/ 7th Asian Regional Conference, June 2012, Adelaide

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Capiphon does not Clog

starts draining sooner, keeps draining longer

CAPIPHON™

Capillary Drainage Technology

Installation
Savings

Lifetime
Savings

Removes 3-4 times
more water

Drains
Sooner

Drains
Longer

Drains
Better



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