Road Pavements Forum

Twenty Second Meeting

CSIR International Convention Centre

Pretoria, Gauteng

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Permeable Concrete Block Paving

Ir. Taco Voogt, PrEng

Permeable Paving Systems

Permeable Paving Systems

May be: -

- **Porous Asphalt**
- **Porous Roadway Concrete**
- **Porous Block Paving**

Permeable Paving Systems

May be: -

- **Porous Asphalt**
- **Porous Roadway Concrete**
- **Porous Block Paving**

Or: -

- **Paving Blocks with widened joints or voids between blocks.**

The Purpose of PCBP is found in: -

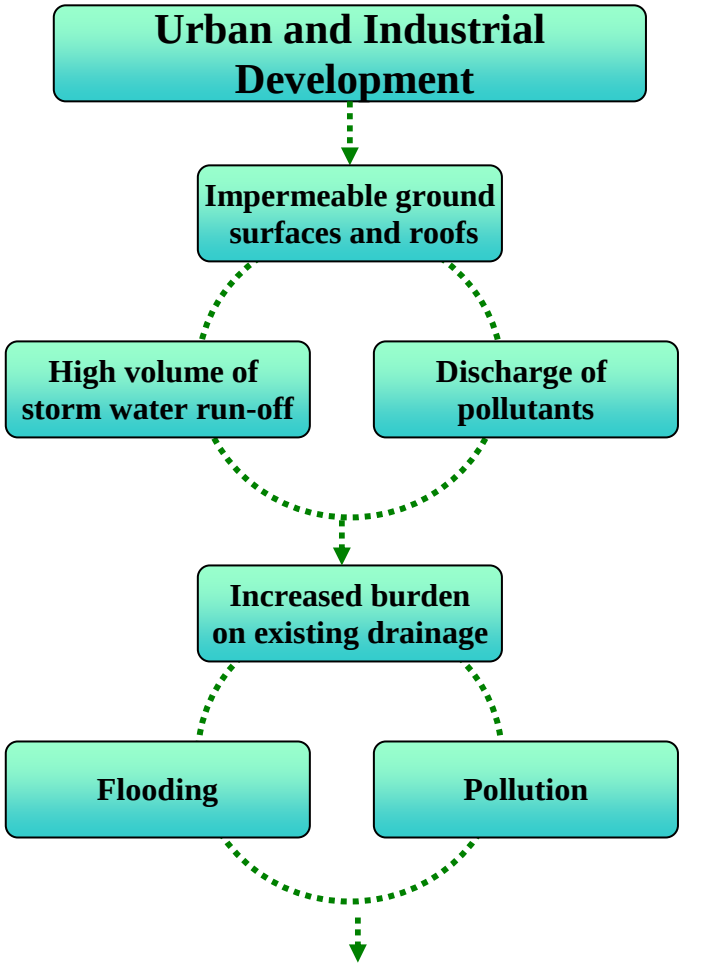
- Stormwater Attenuation
- Stormwater Detention
- Pollution Control
- Water Harvesting

In other countries Stormwater Design and Management is regulated: -

- Sustainable Urban Drainage Systems (SUDS) in the UK.
- Water Sensitive Urban Design (WSUD) in Australia.
- Municipal Taxation in some European countries.
- In the USA, the EPA provides menus of BMP.
- In South Africa regulations in the Municipal By-Laws are increasingly being put into place

The Problem

- 25% of pollution is non point specific
- 90% of surface pollutants are removed by the first flush



- Oils
- Heavy metals
- Detergents
- Organic matter
- Loam
- Pesticides

The Solution

Sustainable Drainage Systems

SUSTAINABLE DRAINAGE SYSTEMS (SUDS)

A Regularity Body will promote Sustainable Drainage Systems (SUDS) as a technique to manage surface and groundwater regimes sustainably.

Sustainable drainage is the practice of controlling surface water run-off as close to its origin as possible, before it is discharged to a watercourse or to ground.

This involves moving away from traditional piped drainage systems to softer engineering solutions that are closer to their natural regimes and help to promote wider environmental objectives.

The SUDS Philosophy

- Manage Water on Site
- Minimise Run-off
- Attenuate Discharge Rates
- Detain Water for Passive Treatment

Traditional solutions to control increase in run-off:

- Increase diameter of storm water drains and channels
- Upsize ditches and culverts
- Build detention ponds
- Install hydraulic controls
- And than: - All run off still needs to be treated at costly sewage works

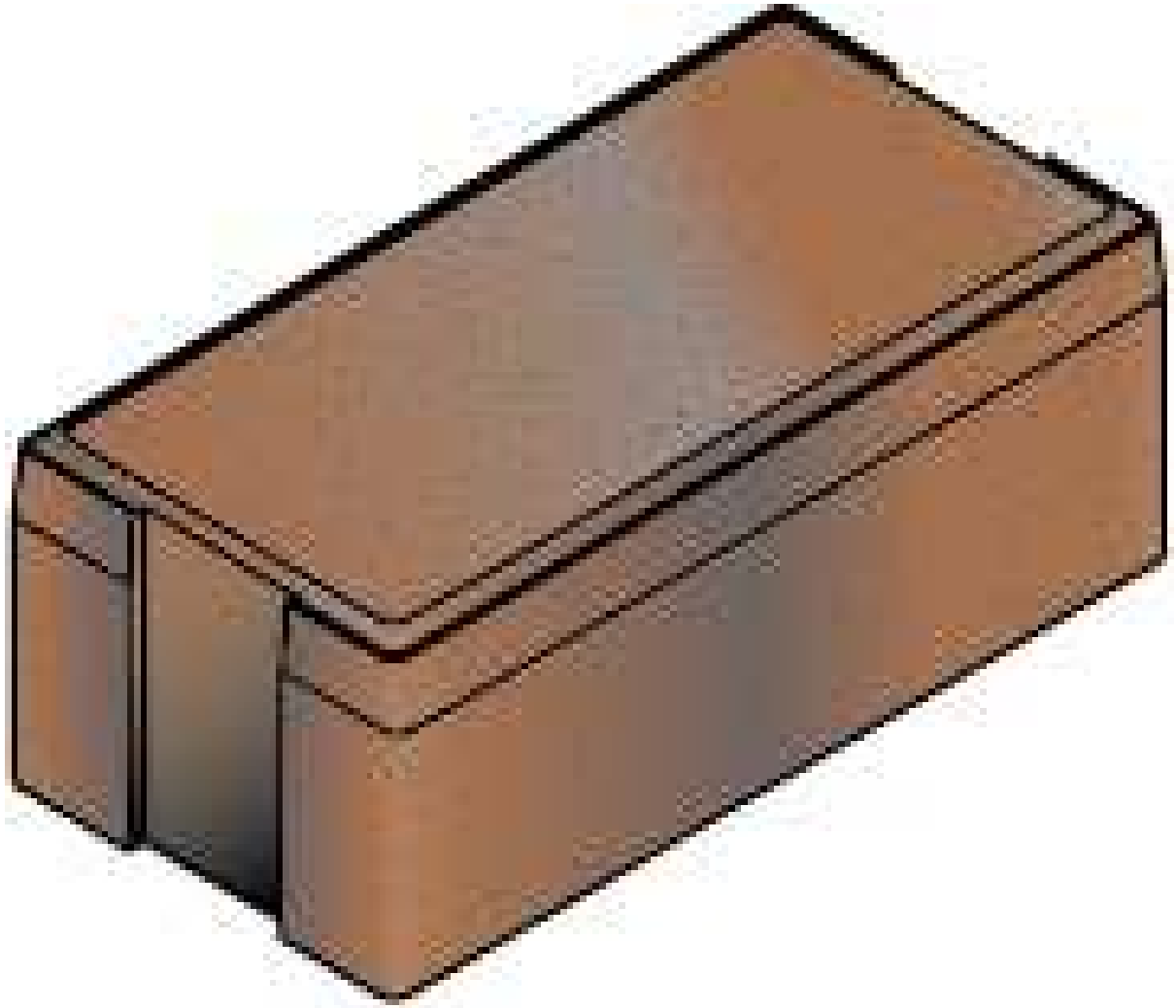
Some of the effects of traditional solutions:

- Increased cost
- Contaminated run-off
- Overloading of combined sewers and sewage works
- Flooding
- Loss of potential development land

There is now a need for Stormwater Source Control that is effective for BOTH
VOLUME and POLLUTION

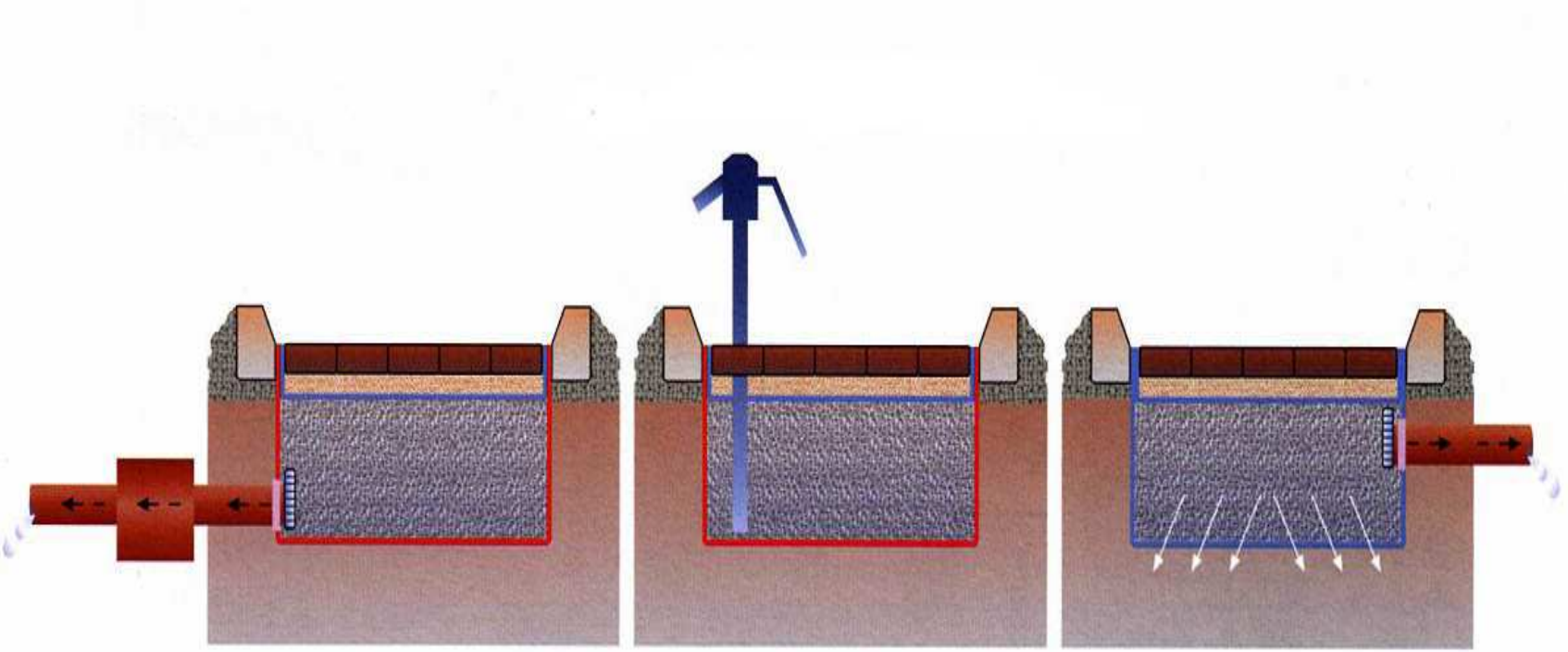

NATURE DEALS WITH RAINFALL BY…..
EVAPOTRANSPIRATION
EVAPORATION
ABSORPTION
RUN-OFF 2-5%


In urban developments
run-off increases to 75-90 %



Permeable Paver

Some alternative system designs:



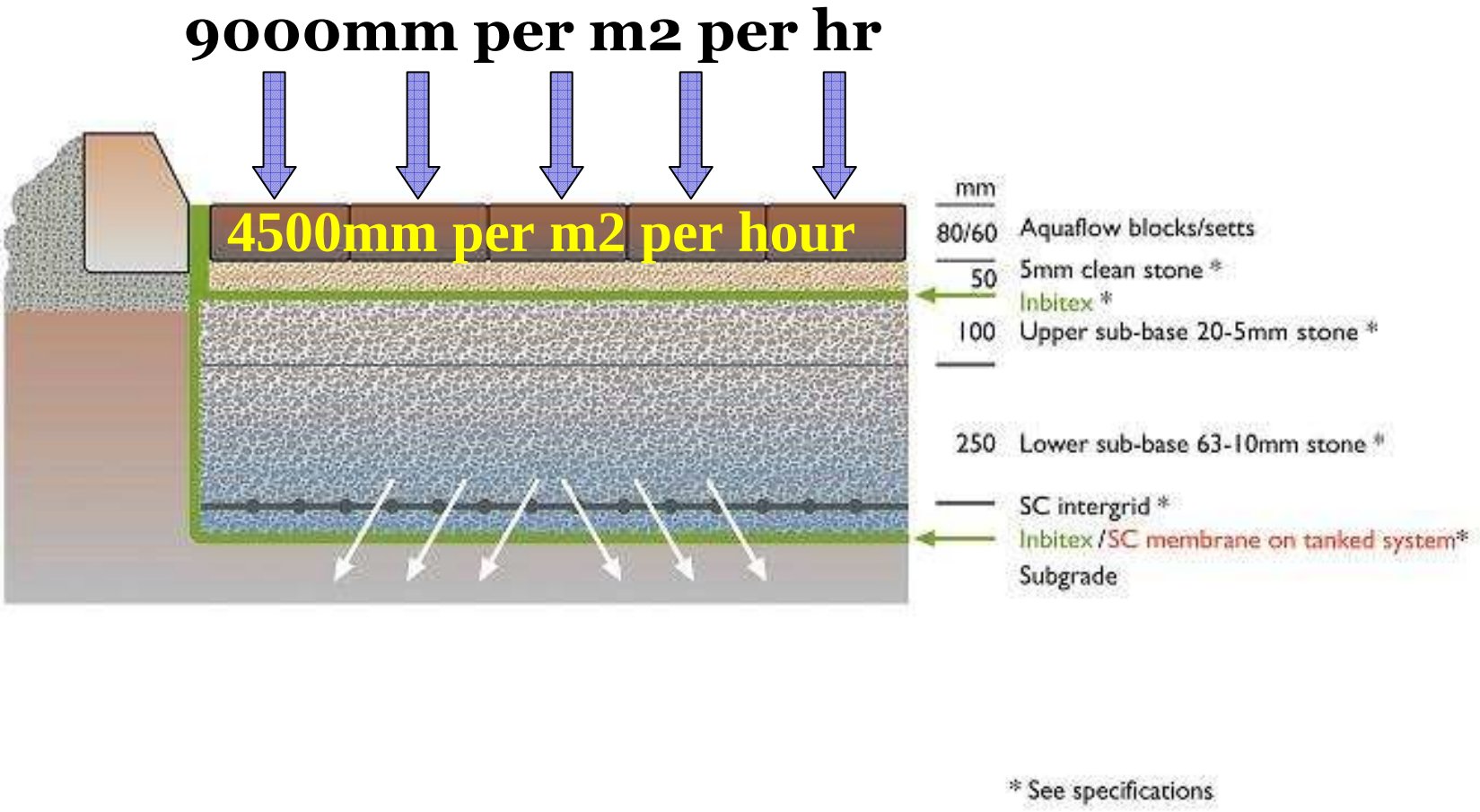
Tanked with additional treatment before reuse

Tanked storage/reuse

Infiltration/overflow

Typical Infiltration system with a sub-grade CBR of between 2-5%

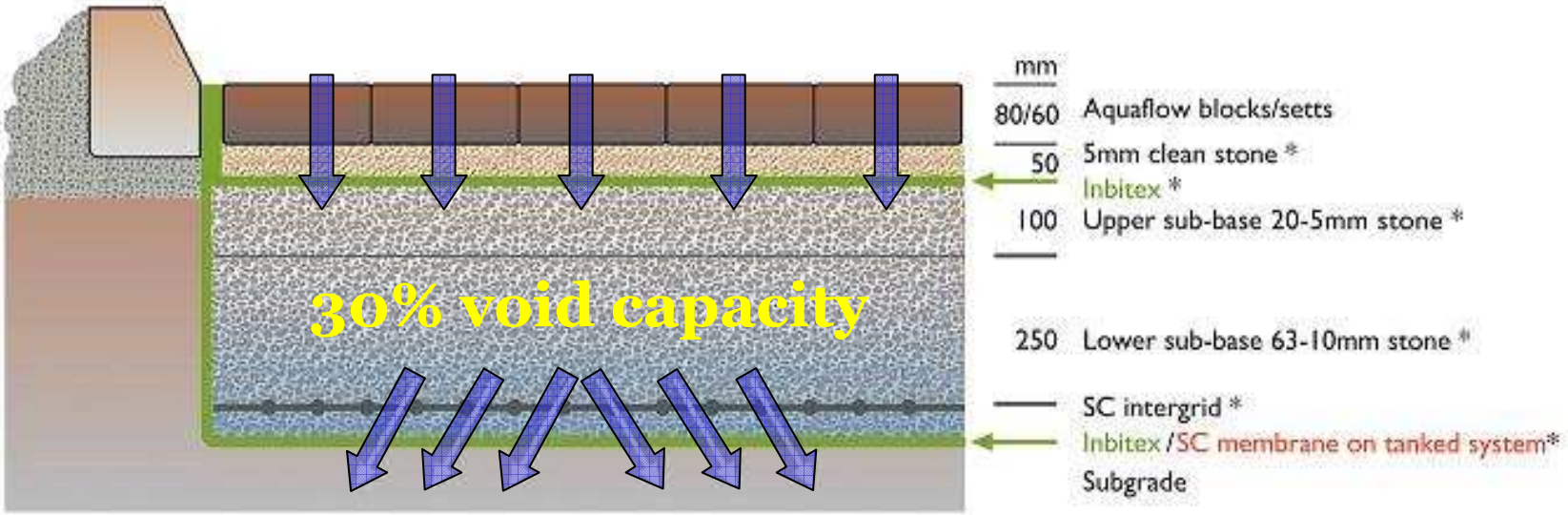
Parking areas subject to trafficking by cars and vans only



* See specifications

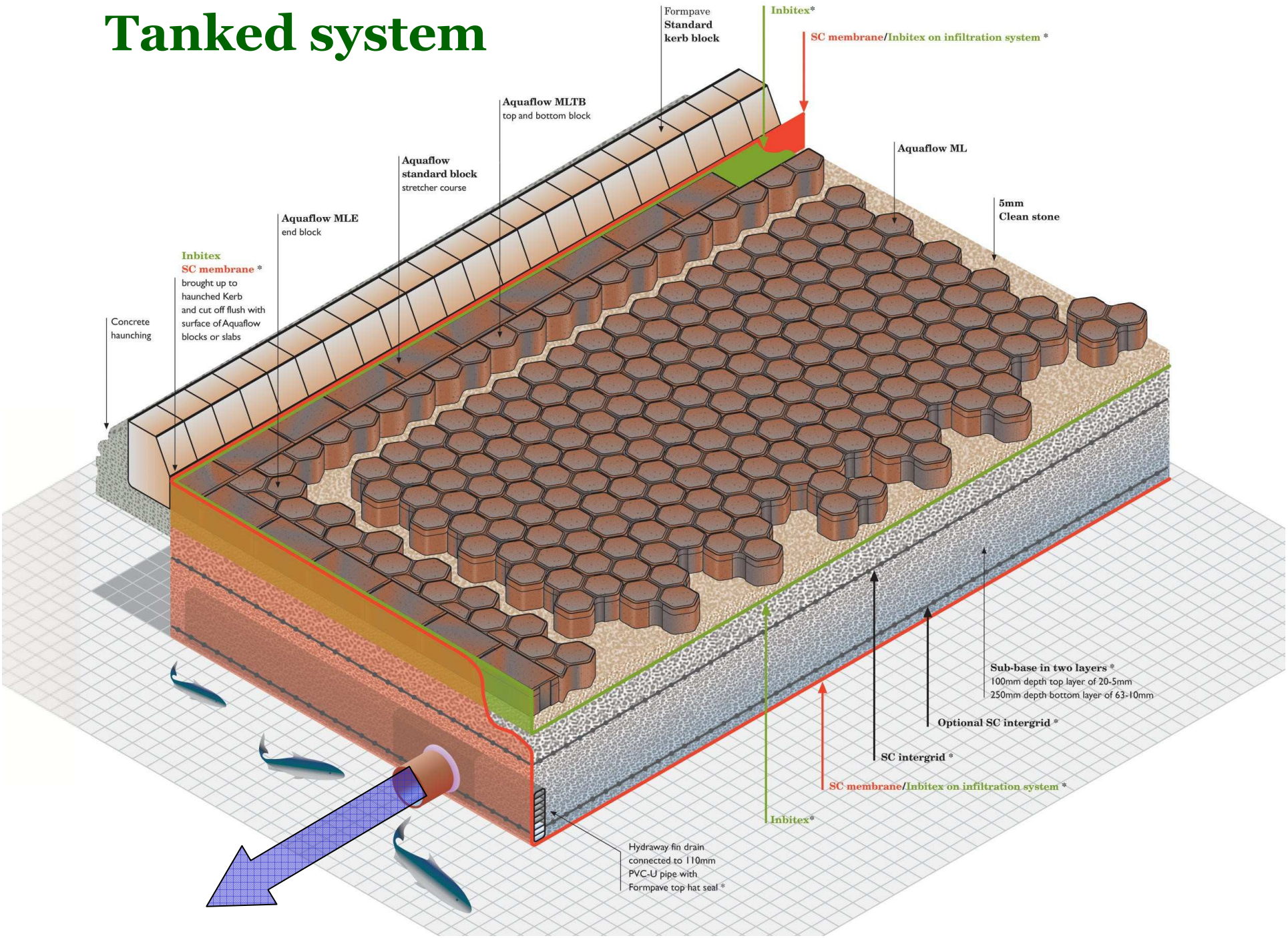
Typical Infiltration system with a sub-grade CBR of between 2-5%

Parking areas subject to trafficking by cars and vans only



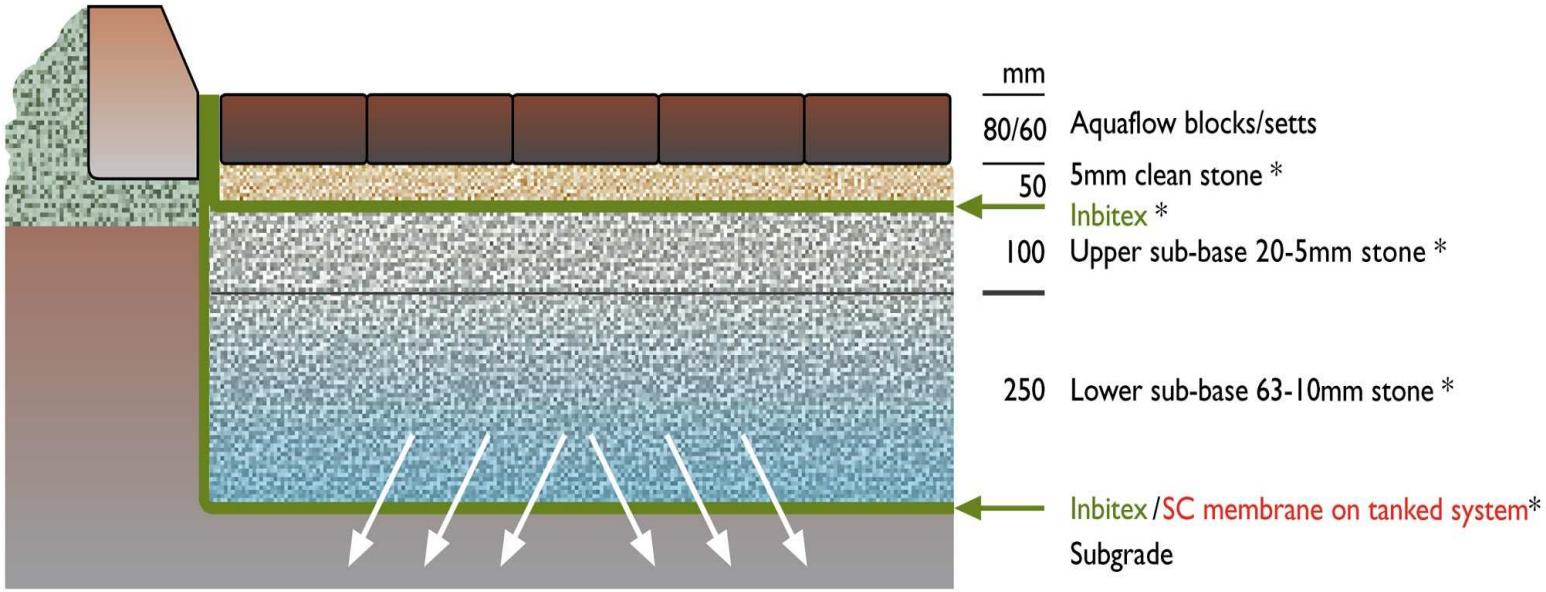
* See specifications

Tanked system

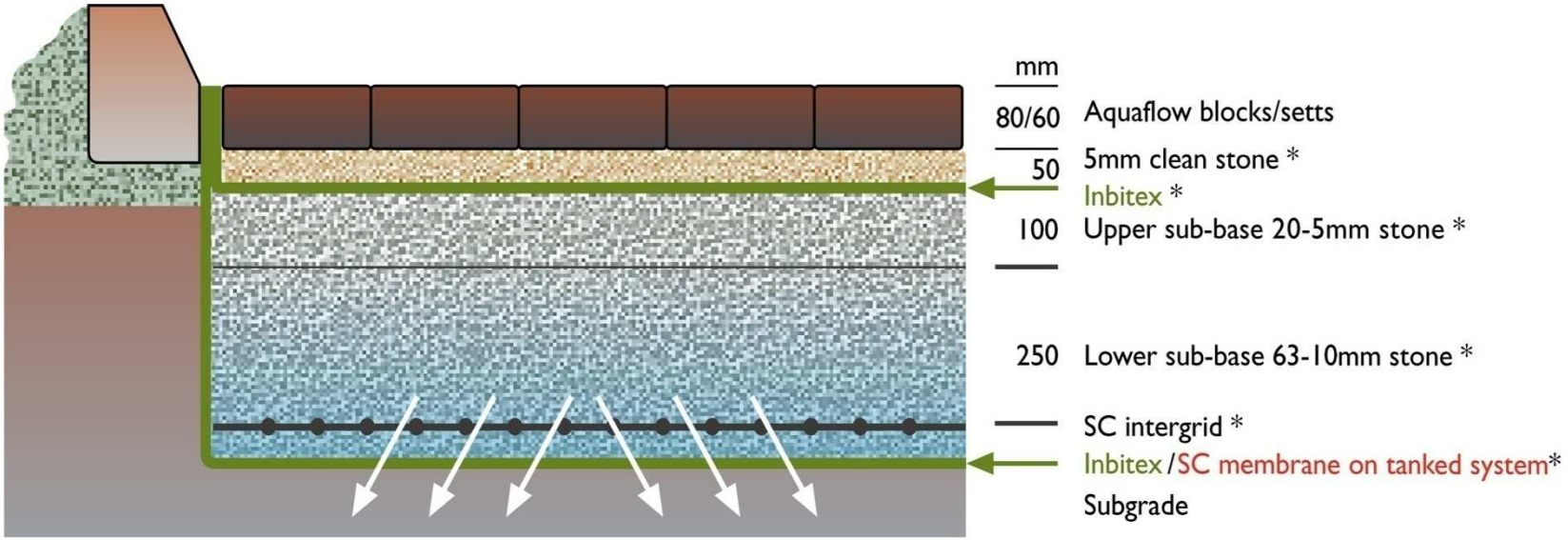


Typical Infiltration system with sub-grade CBR of 5% or greater

Paved areas subject to trafficking by Light Duty Vehicles

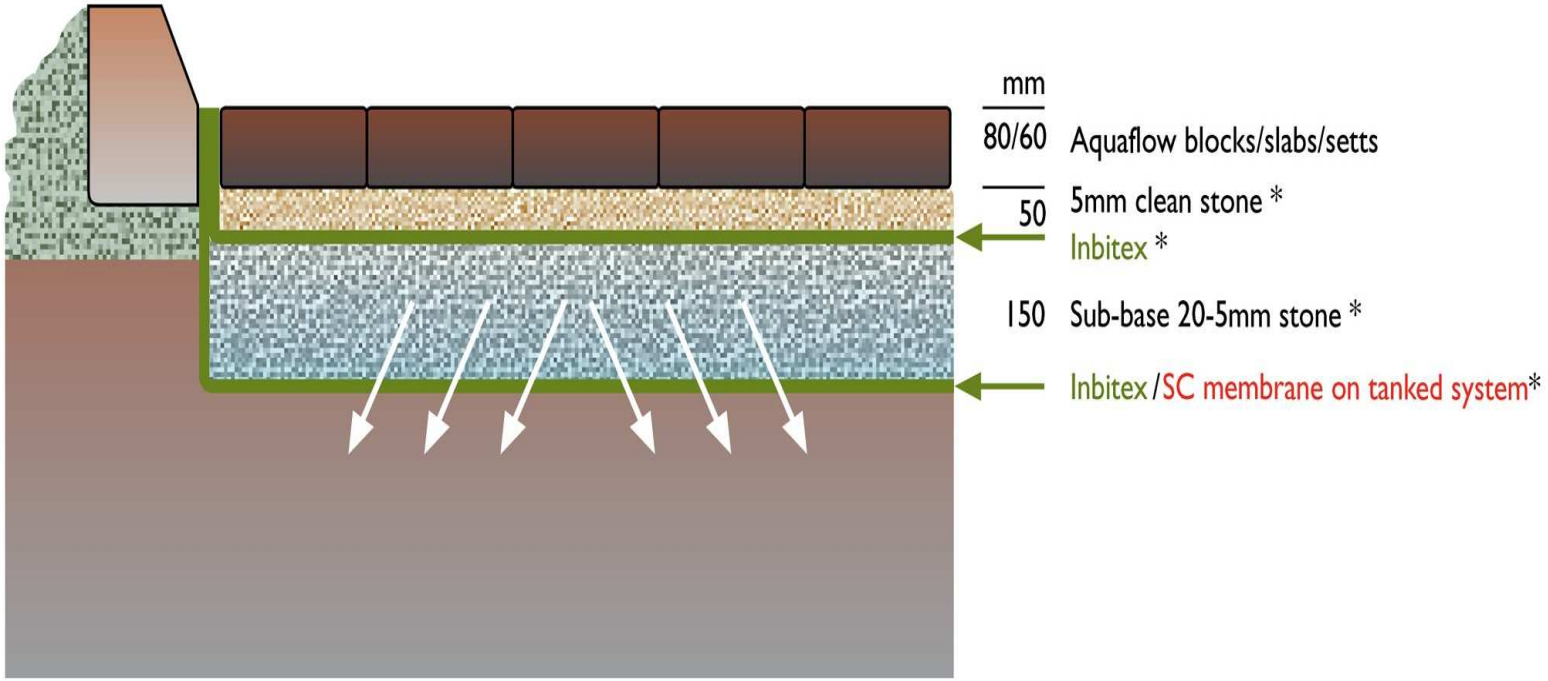


Typical Infiltration system with sub-grade CBR of 5% or greater
Paved areas subject to trafficking by Heavy Duty Vehicles



* See specifications

Typical Footpath Construction with lower capacity requirements



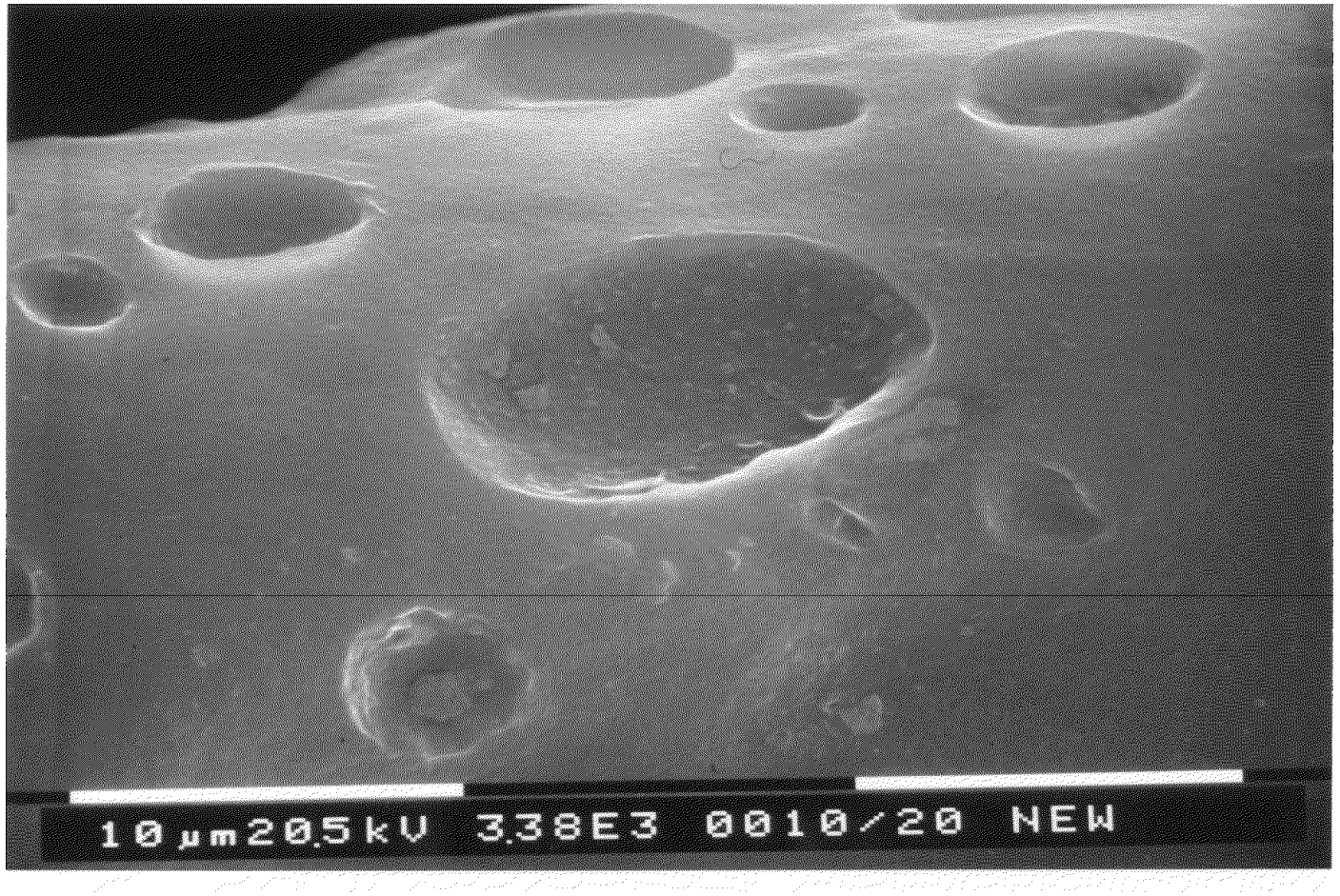

20-5mm Clean Stone Upper Subbase
INTERGRID
63-10mm Clean Stone Lower Subbase
GEOTEXTILE


3mm **jointing grit**
BLOCK
5mm Single Size Bedding
INBITEX
20-5mm Clean Stone Upper Subbase
INTERGRID

Inbitex

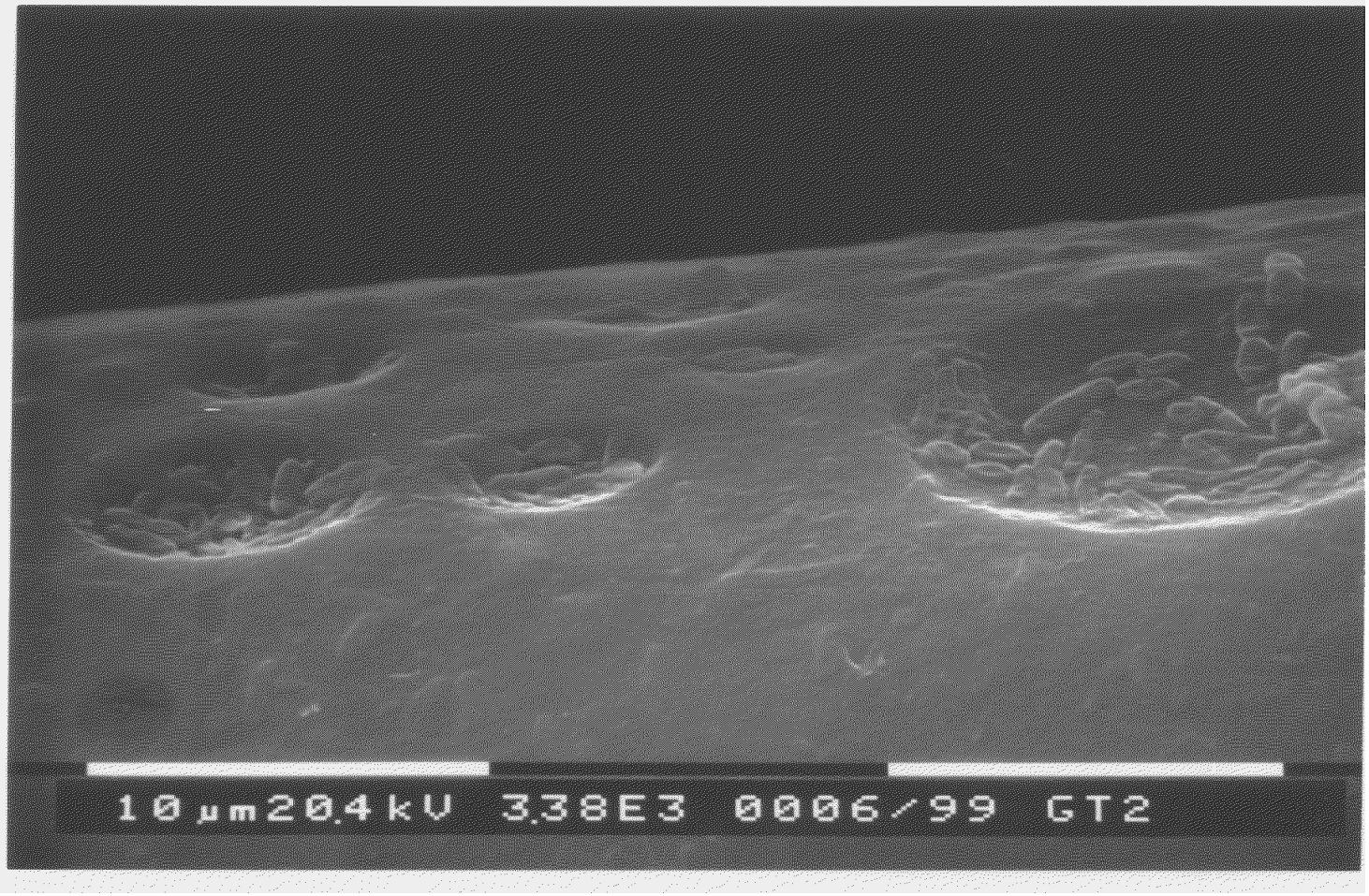
- is a thermally bonded non woven geotextile that has been developed specifically to optimise the cleansing of water entering the sub-base system.
- it has various characteristics that have been combined to create a geotextile that is unique and allows flow whilst controlling pollution.
- it is a geotextile that aids the development of the naturally occurring microbes, and also offers a refuge during periods of drought.

Clean geotextile



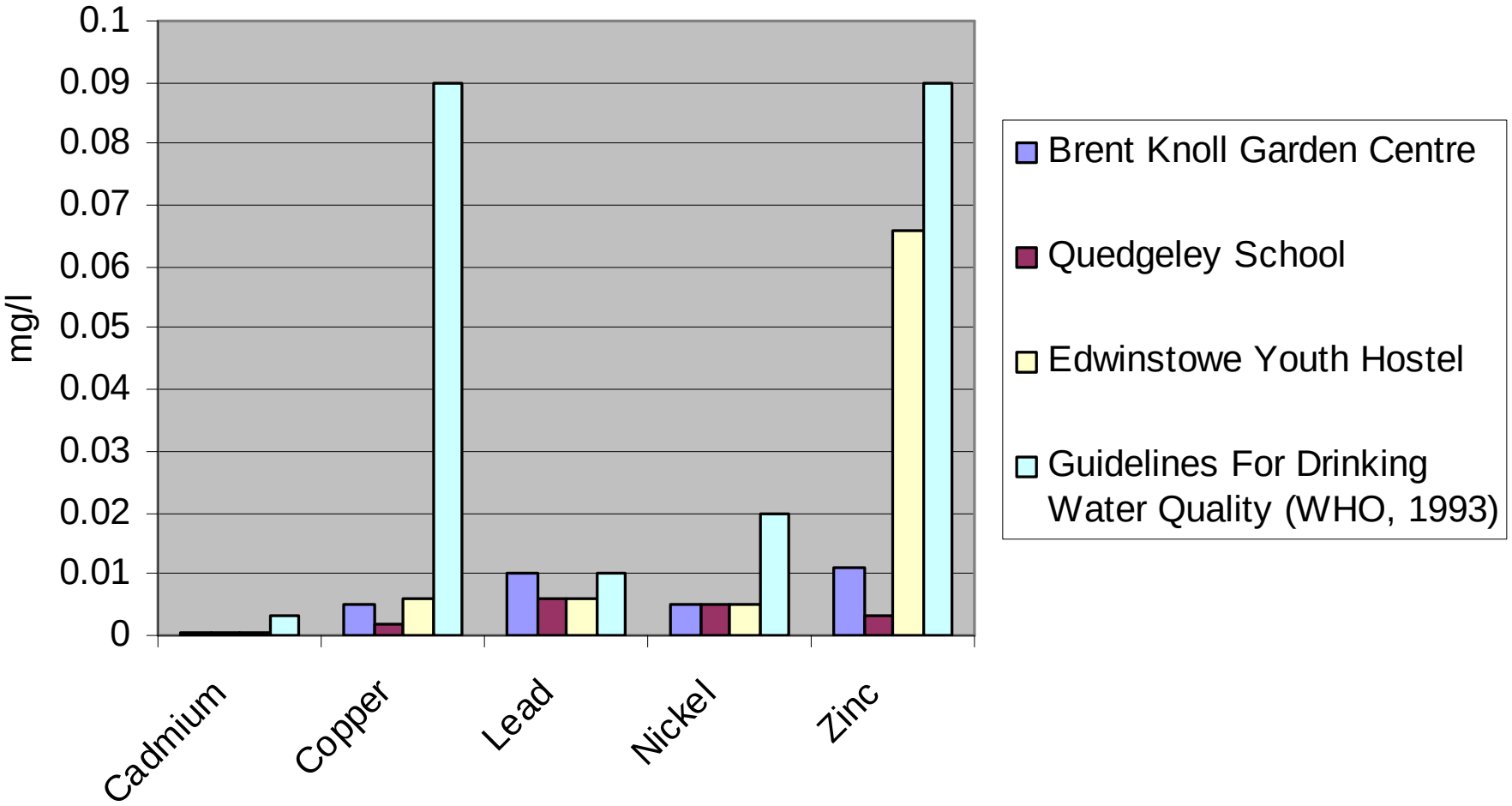
Photograph provided by Stephen Coupe of the School of the Built Environment, Coventry University

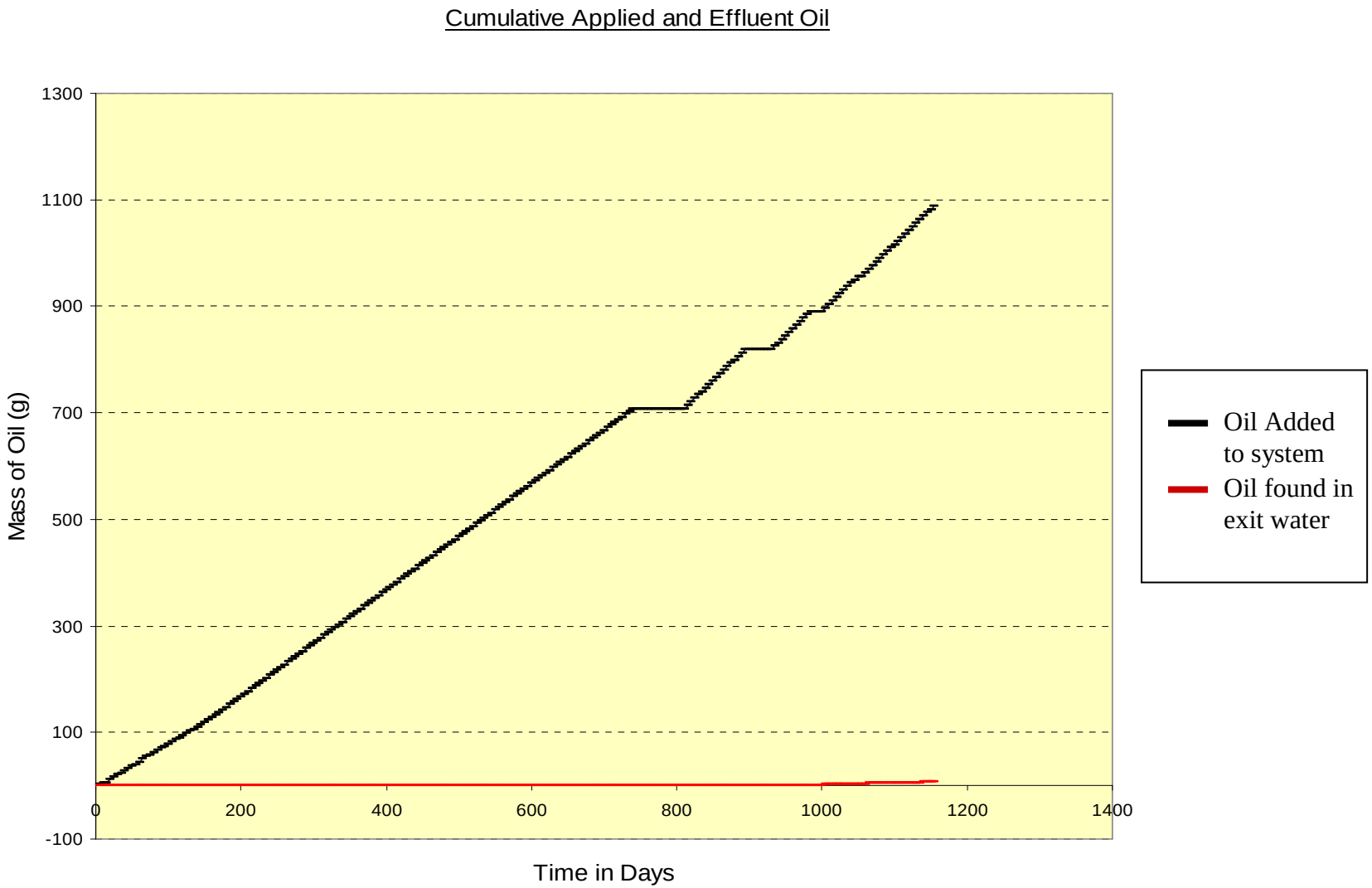
Initial biofilm formation



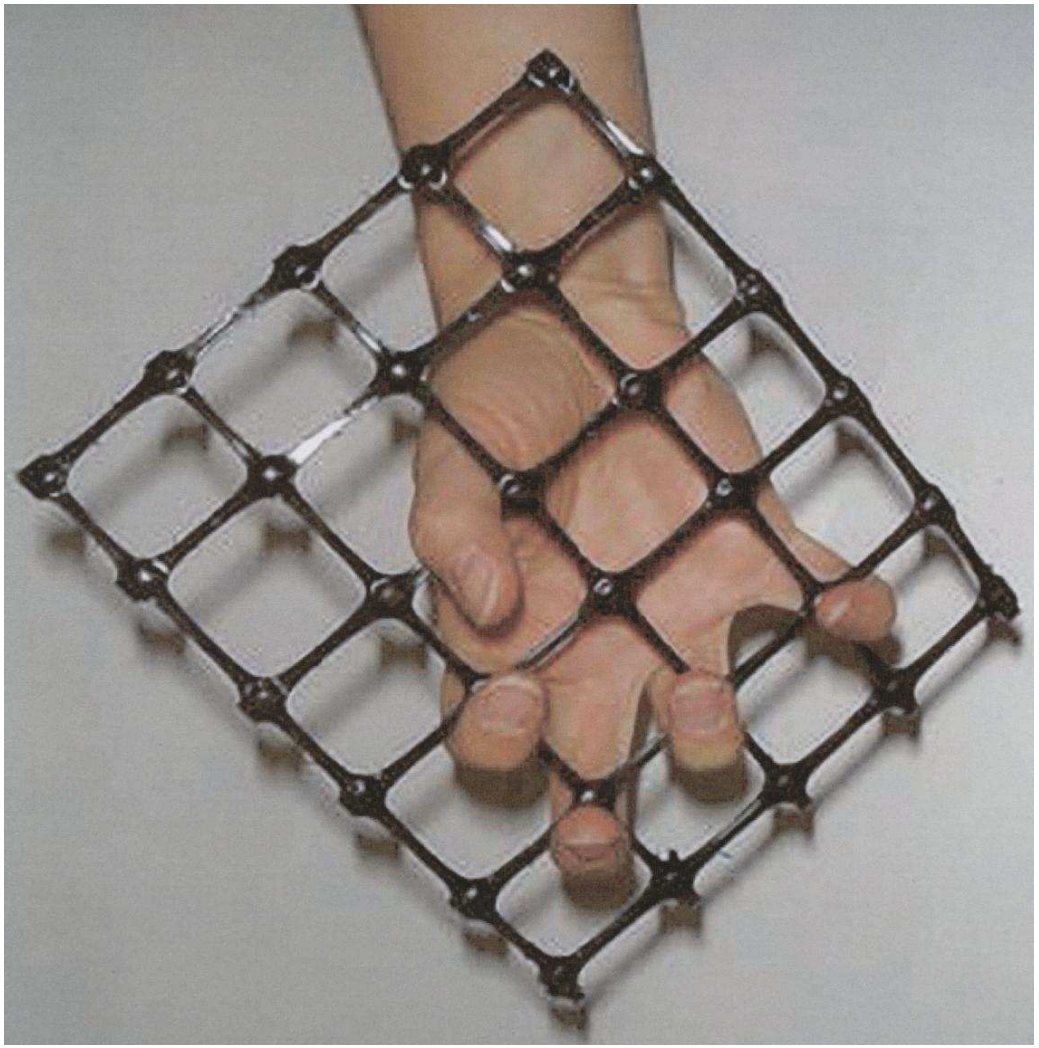
Photograph provided by Stephen Coupe of the School of the Built Environment, Coventry University

Formpave Stormwater Source Control System
Analysis of Heavy Metals in Exit Water





PJdata2. Data provided by kind permission of Stephen Coupe of the School of the Built Environment, Coventry University



SC Intergrid, Flexurally stiff, rigid integral Geogrid structure resists horizontal shear.

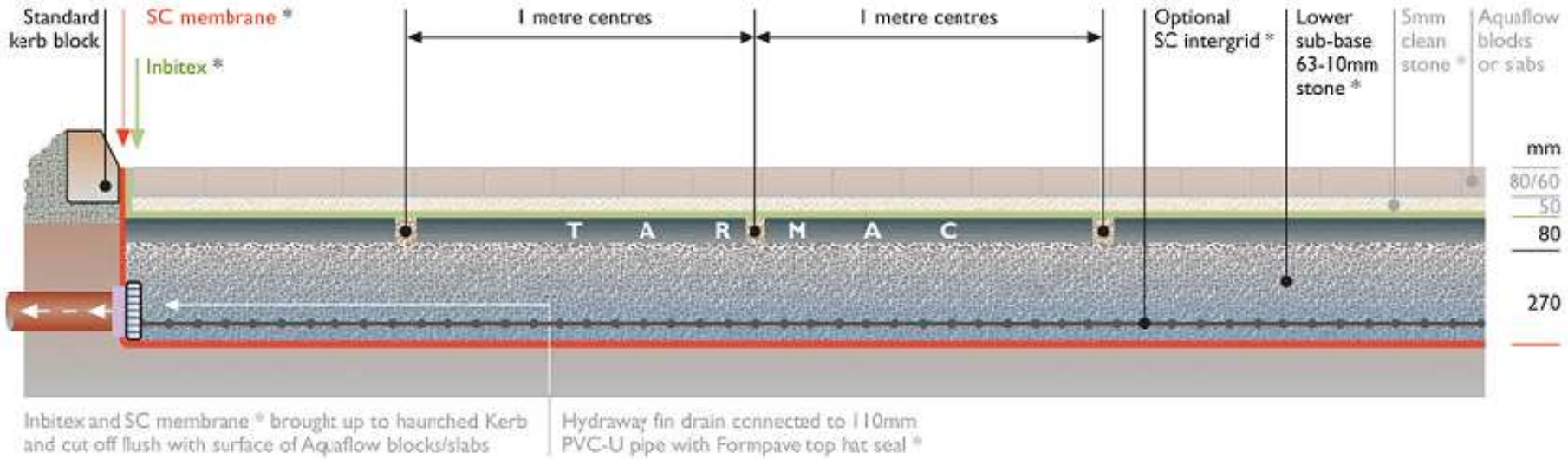
Mechanical Interlock through rigid confinement of granular particles


Formpave®
Quality concrete paving products


M.F. FREEMAN

Construction running surface

Tanked system section Aquaflow pavement with undersealing membrane



- Lay SC membrane, optional intergrid, 270mm of sub-base and SC intergrid
- Lay 80mm of dense base course Tarmac over sub-base (see specification)

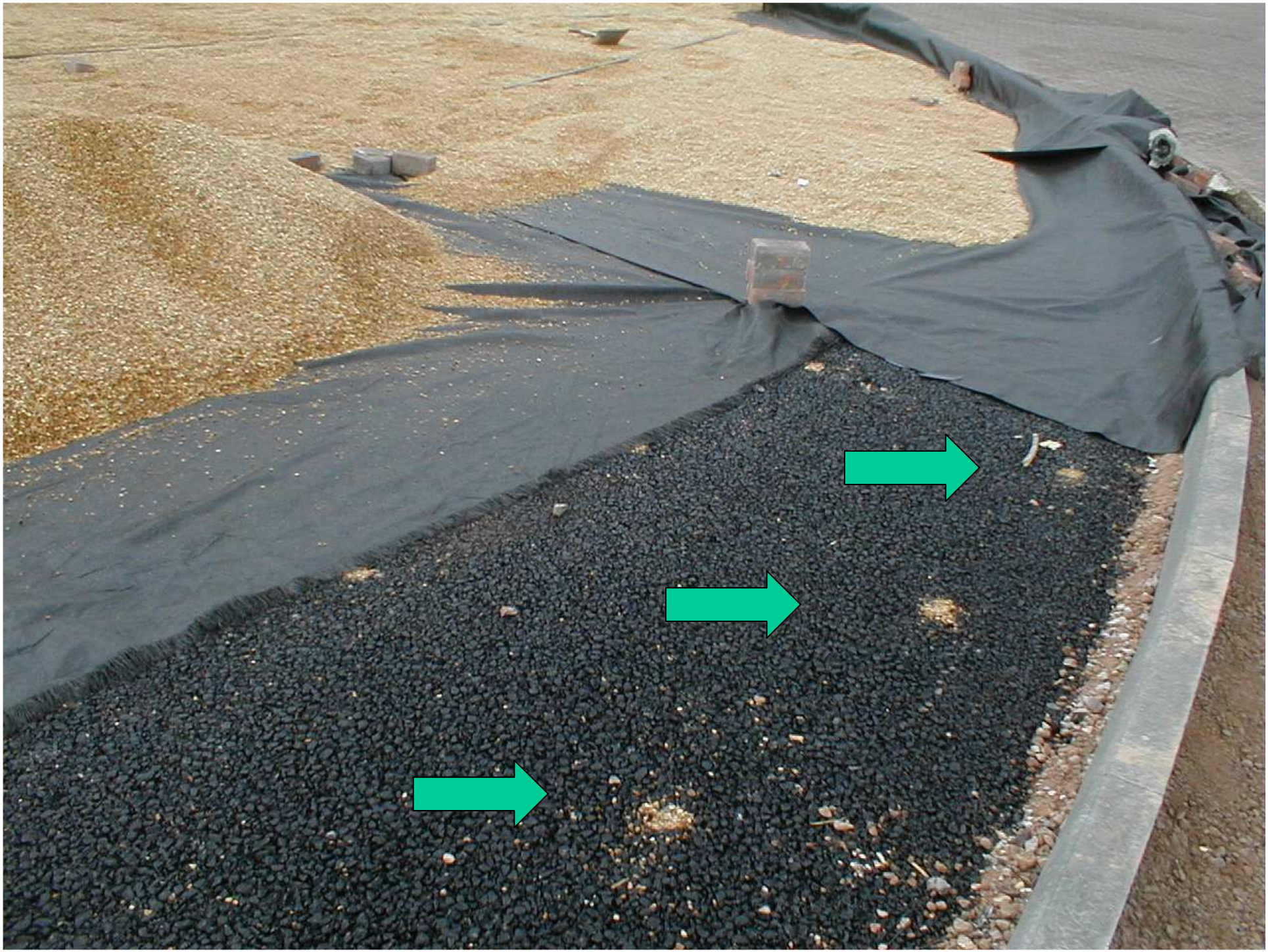
After building work is completed

- Clean tarmac surface
- Cut 20/50mm diameter holes at 1 metre centres through tarmac surface into sub-base
- Fill holes with 5mm clean stone
- Lay Inbitex, 5mm laying course and Aquaflow blocks or slabs

This illustration features the tanked system. For the infiltration system replace SC membrane with Inbitex.

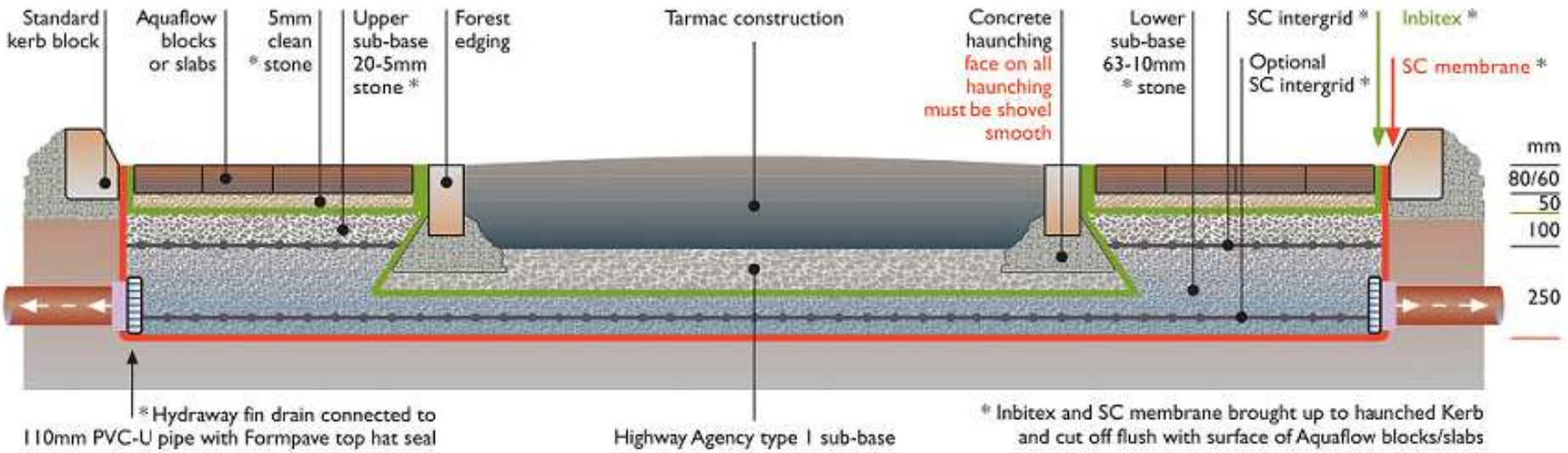
* See specifications


Formpave®
Quality concrete paving products



Aquaflow paving in conjunction with tarmac road surfaces

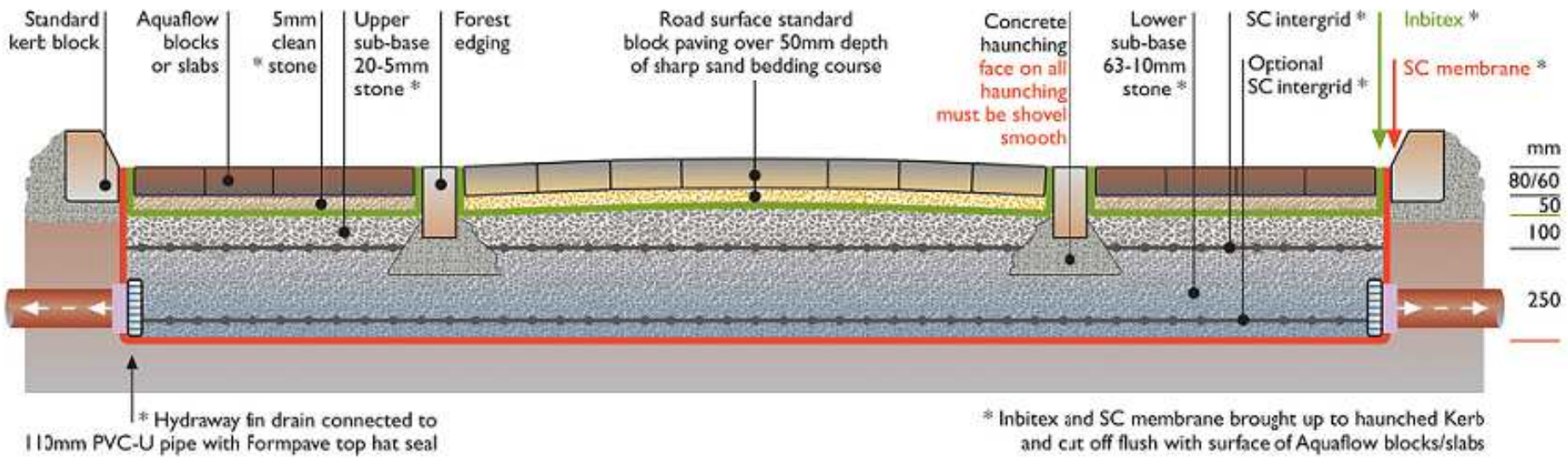
Tanked system section Aquaflow pavement with undersealing membrane




TESCO

Aquaflow paving in conjunction with standard block paved road surfaces

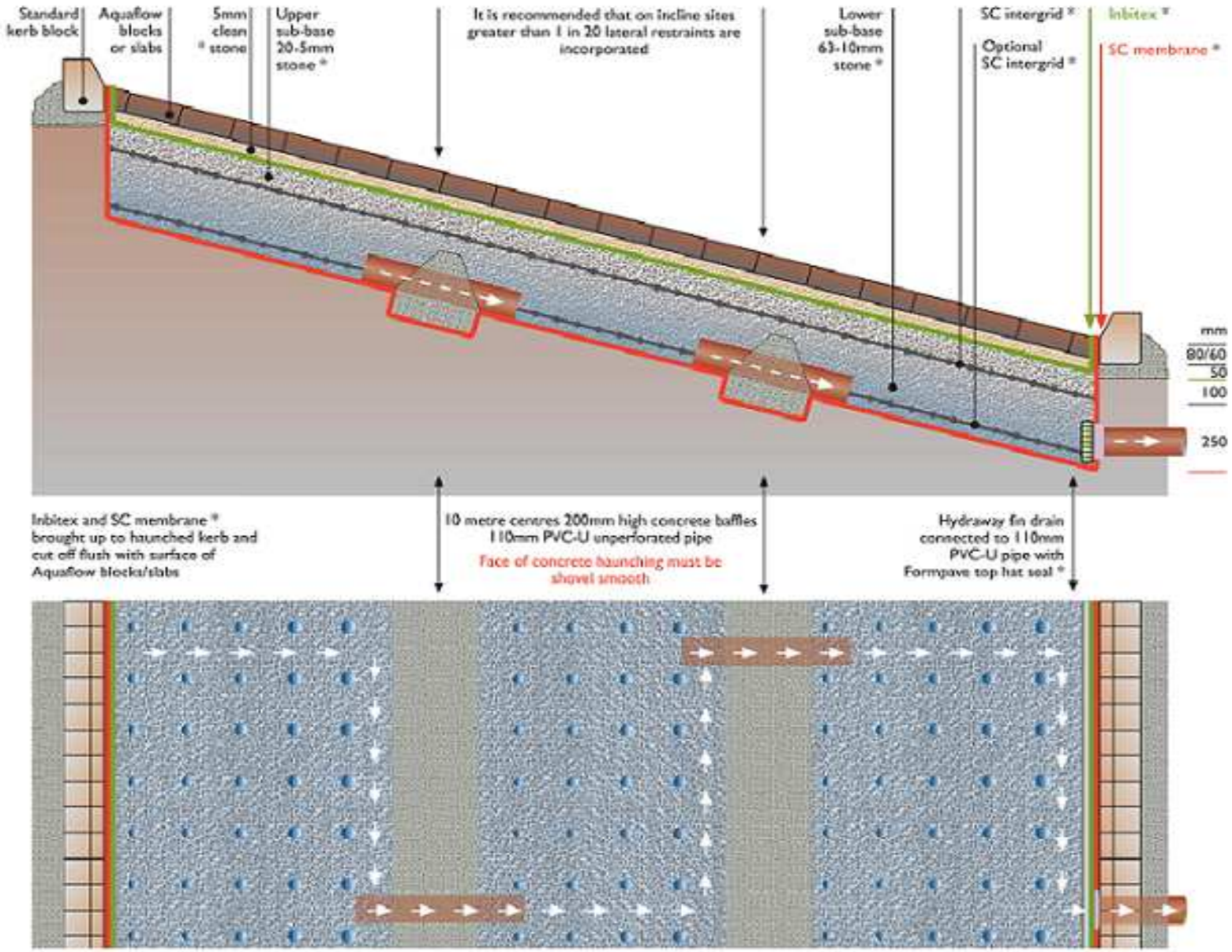
Tanked system section Aquaflow pavement with undersealing membrane




T48 MLA

Sloping sites tanked system

Aquaflow pavement with undersealing membrane *also see plan*

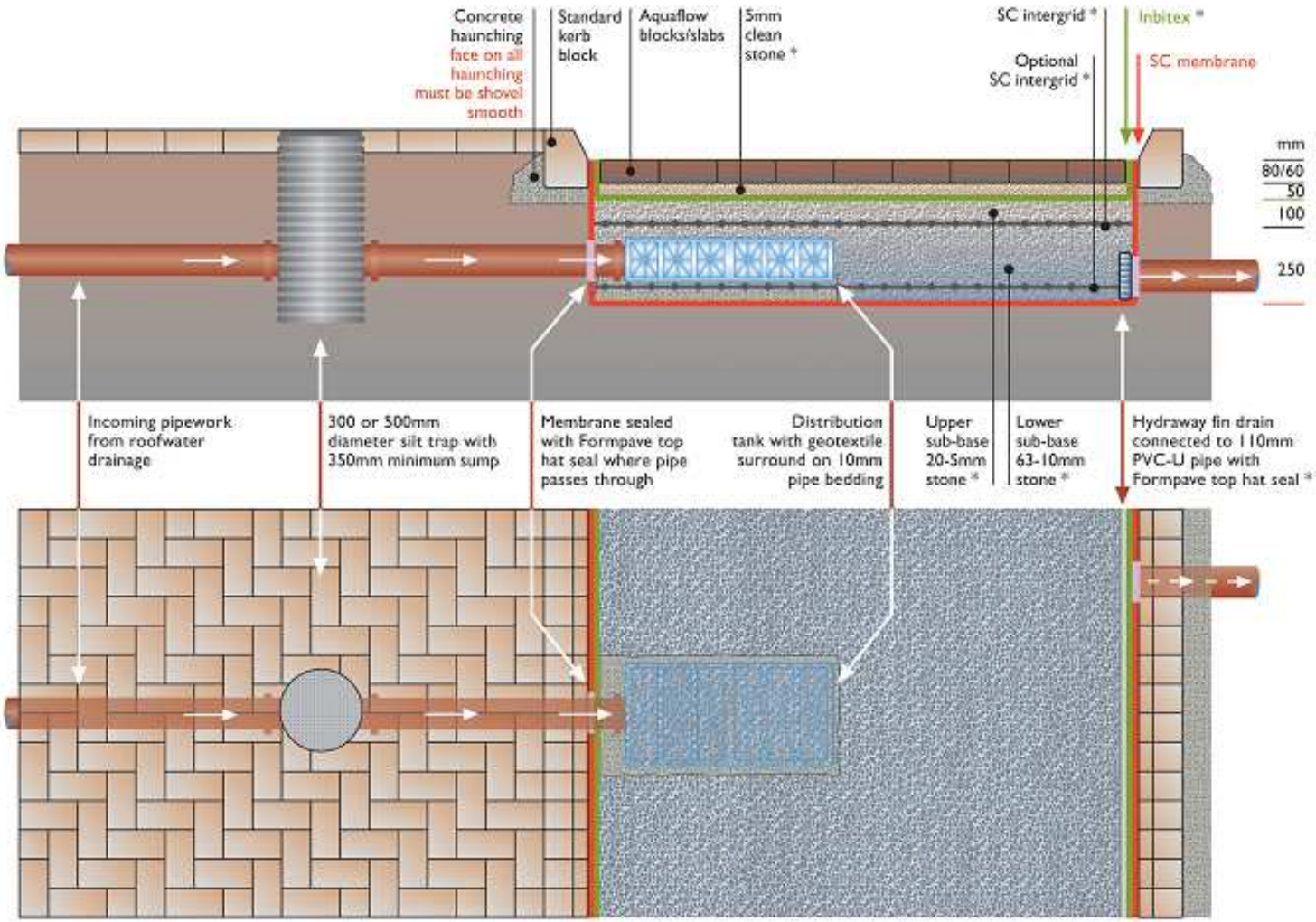


Sloping sites infiltration system

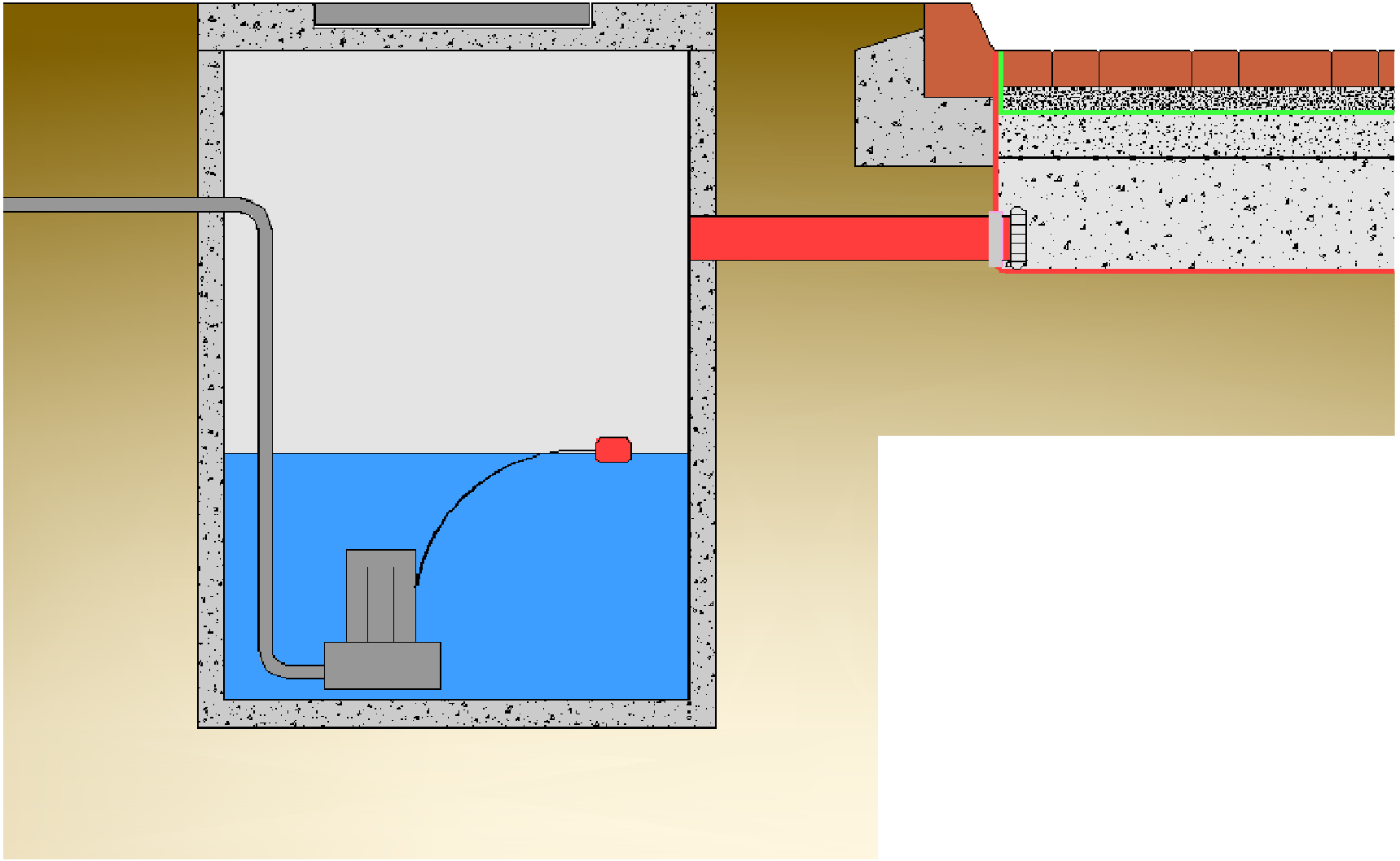
Aquaflow pavement with no undersealing membrane

Down pipe drainage into tanked system

Aquaflow pavement with undersealing membrane



Schematic Drawing of Typical Sump and Pump Layout for Water Harvesting



Cost of construction above reduced level:

- Insitu reinforced concrete pavement :
  Cost of construction **plus** all drainage, connection and detention costs
- Conventional concrete block paving
  Cost of construction **plus** all drainage, connection and detention costs
- Properly engineered premix asphalt paving:
  Cost of construction **plus** all drainage, connection and detention costs

- **Permeable Concrete Block Paving, geotextiles and stone:**
  Cost of construction No add on costs

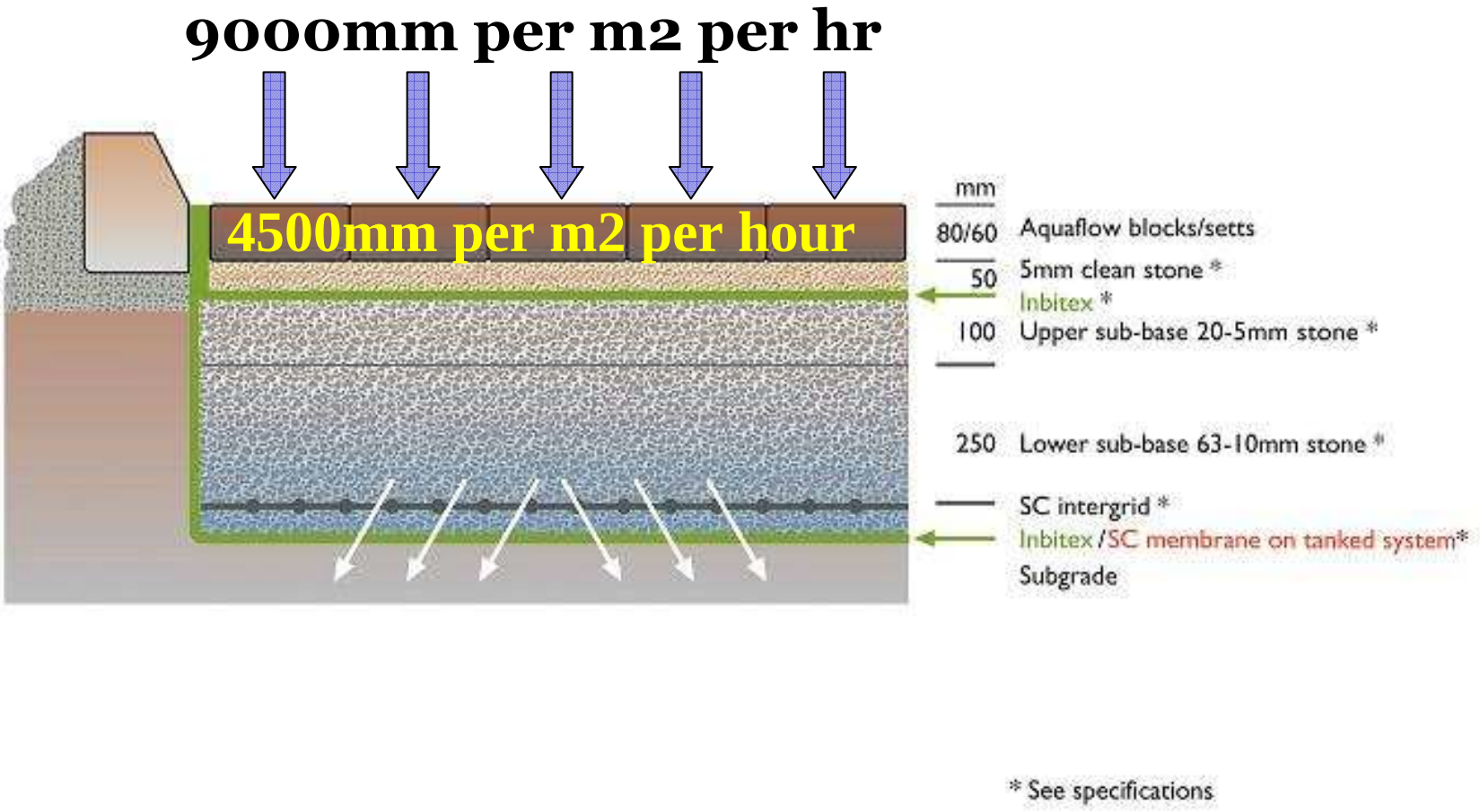

Pro-active Maintenance:
Brush Bi-annually

Long-Term Performance:

- Prof. John Argue, Urban Water Research Centre University of South Australia
- Typical urban area run-off :
- 580mm rainfall per annum, Silt loading of 200ppm
- 1:1 ratio of permeable / impermeable surfaces
- Predicted surface permeability :
- ***Permeability reduced by approx 40%***

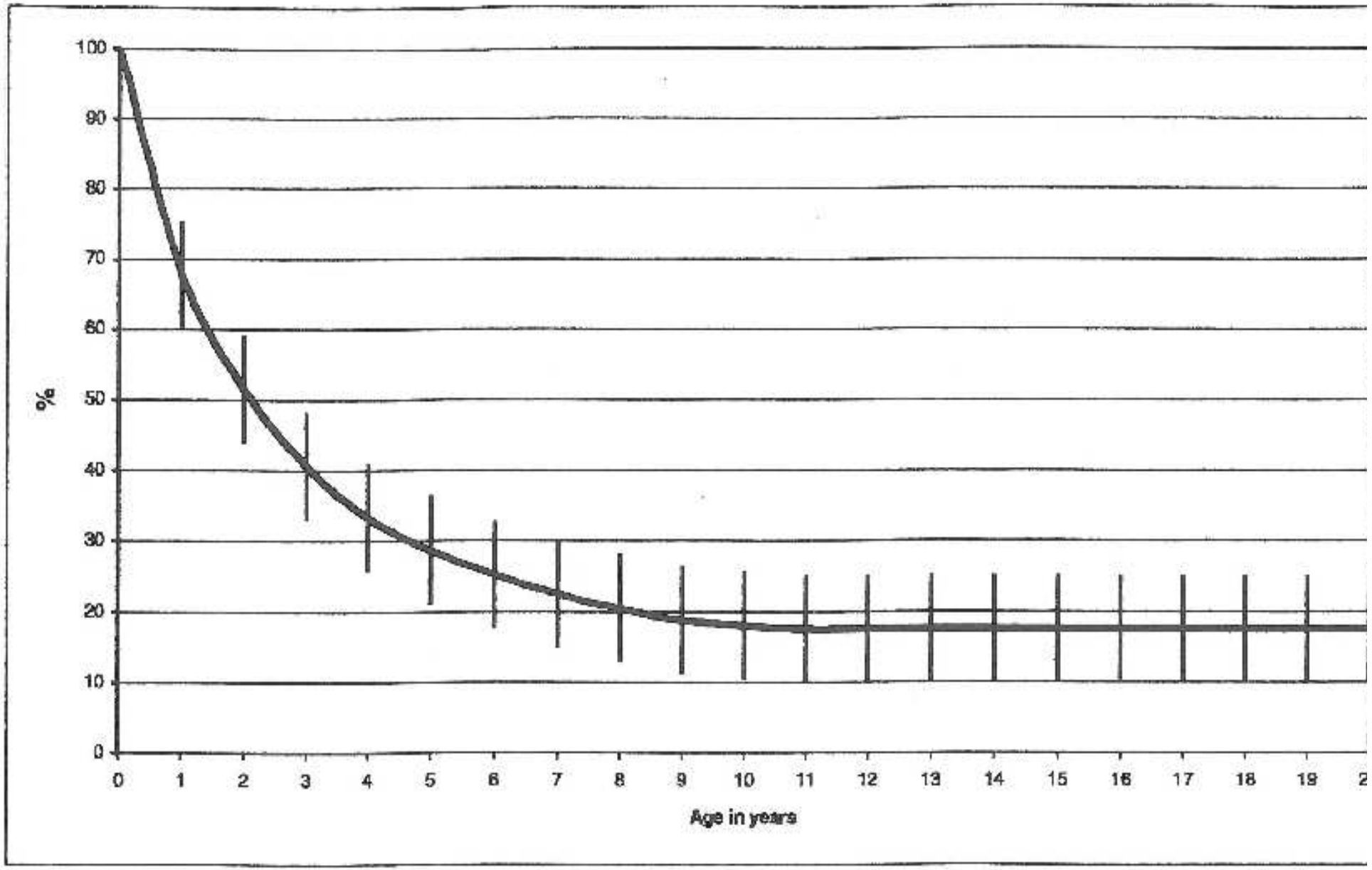
Typical Infiltration system with a sub-grade CBR of between 2-5%

Parking areas subject to trafficking by cars and vans only



* See specifications


Testing permeable pavements in Germany after 22 years of service Sonke Borgwardt found that the permeability of the pavement was reduced to approximately 15% of the original value, still vastly exceeding the required 270mm/m2/h.


100
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16
17
18
19
Age in years

Long–term Maintenance

After time, parts of laying course may become filled with silts and toxins.

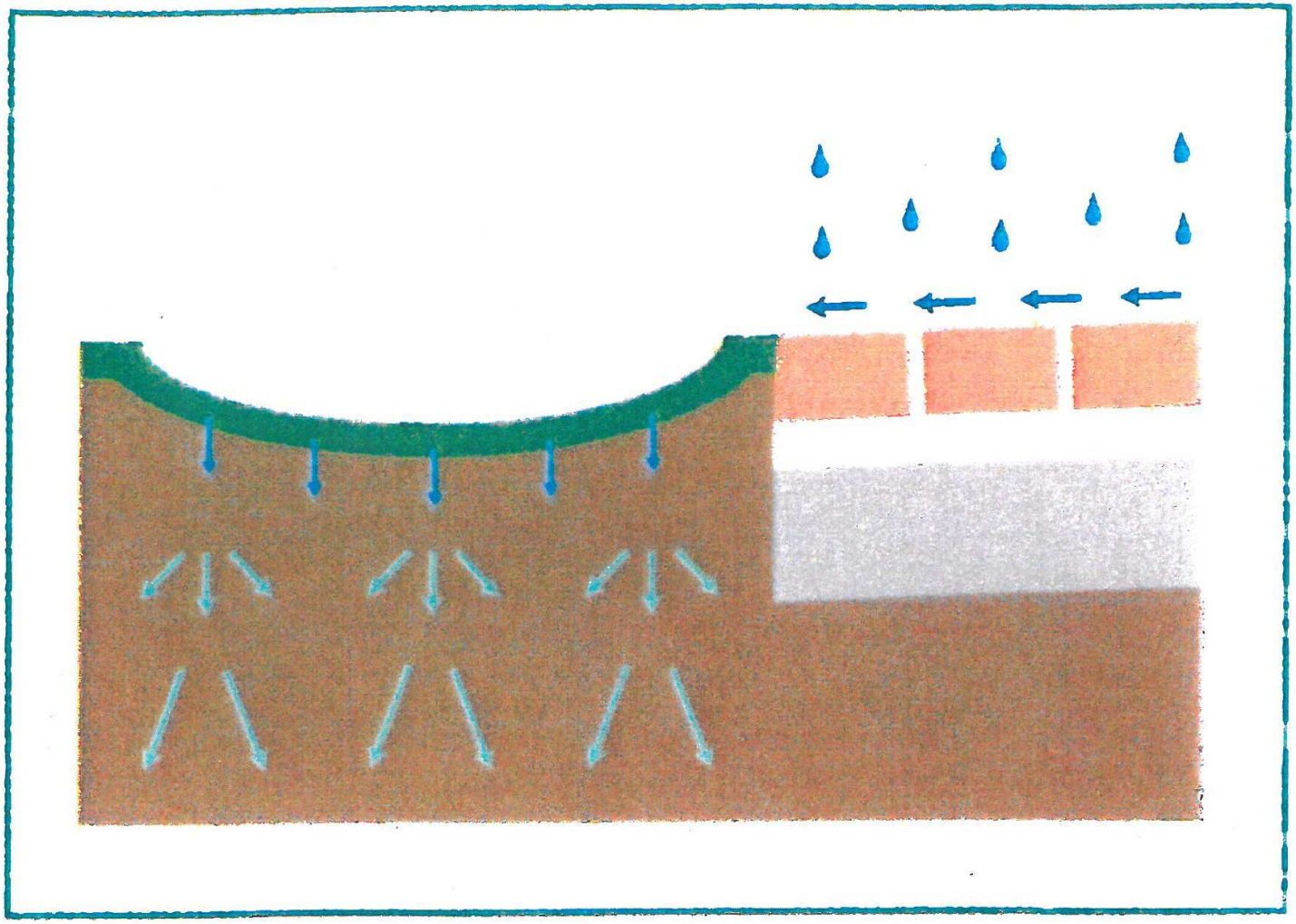
Uplift surface blocks.

Dispose of laying course and geotextile.

Leave the existing sub-base in-situ.

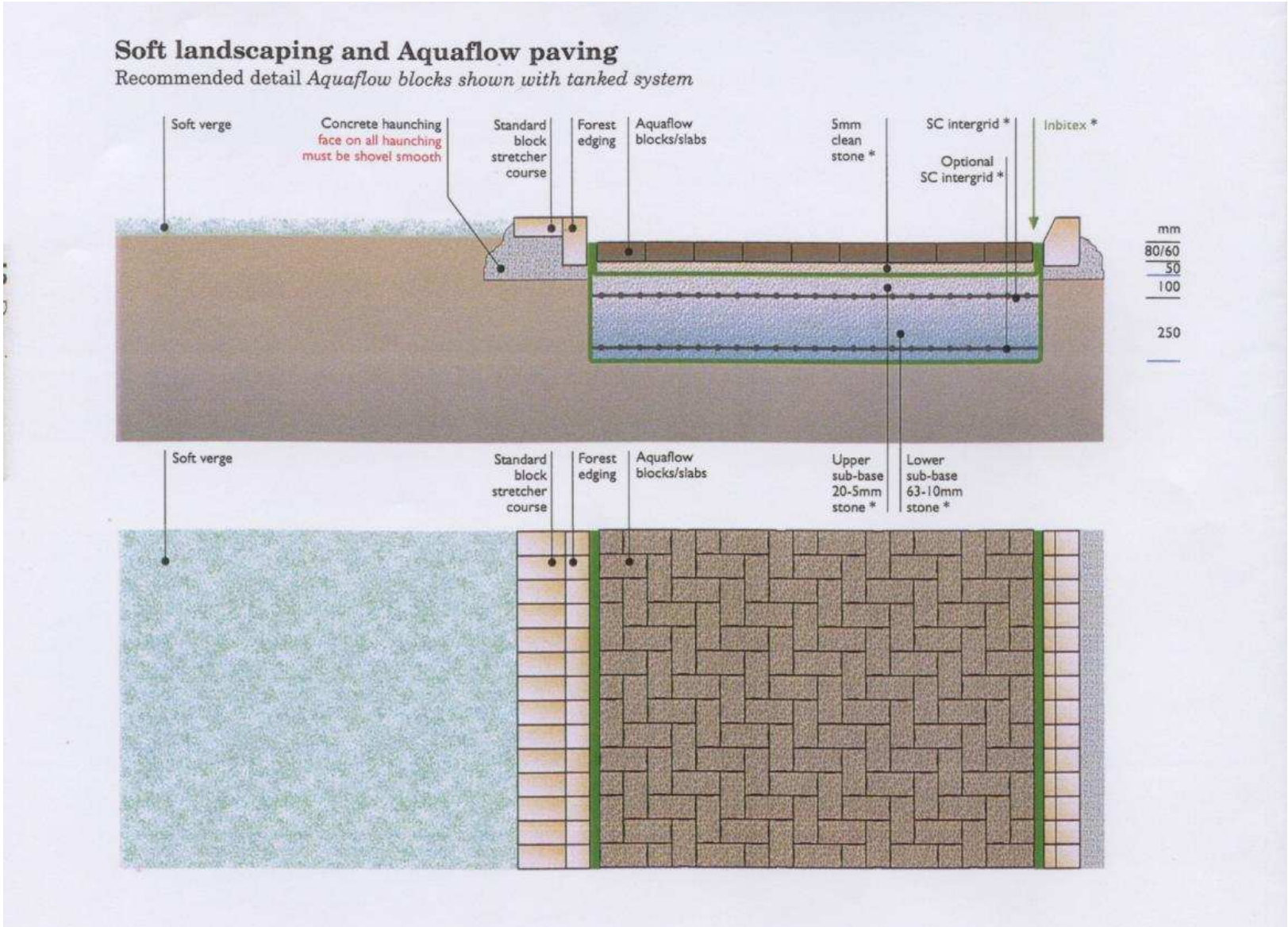
Replace fresh laying course and geotextile.

Relay blocks.



Soft Landscaping and Aquaflow paving

Recommended detail to **STOP** soil wash down




Soldier course
Soft Landscaping


OLD MUTUAL

Summary

- Water drains through vertical channels in blocks
- Organic matter and loam is caught on the geotextile and held in the 5mm stone layer
- Oils and heavy metals coat surface of organic matter and loam and remain in laying course
- Natural microbial population digests low level hydrocarbon pollution
- Clean water exits from the system

Principal benefits of storm water source control :

- Lower capital cost and maintenance
- No requirement for falls, gully pots, drain runs, oil or silt traps, hydro controls
- Reduced land take
- Roof water discharged directly into sub-base
- Control of run-off and pollution
- Water available for secondary use
- Recharge of ground waters

Credits

- Hanson Formpave
- Dr. Brian Shackel
- Dr. Sönke Borgwardt
- Murray & Roberts Building Products
- Inter Pave
- Scott Wilson
- Concrete Manufacturers Association

Thank you.