mpa Precast

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Retrofit SuDS & Permeable Paving Bridget Joyce Square & White City

Case studies exploring new concrete block permeable paving techniques for retrofit SuDS plus urban regeneration and street tree sustenance.

Mineral Products Association

Introduction

Originally built during the 1930s and '40s, the White City Estate in London Borough of Hammersmith and Fulham is home to a number of innovative sustainable drainage system (SuDS) projects. Our first case study looks in detail at the award-winning Bridget Joyce Square in Australia Road – a multifunctional SuDS park with community at its heart and an exemplar for future urban landscapes, driven by multiple stakeholders. It utilises permeable paving overlays to regenerate existing impermeable road-bases, providing a gradual flow of clean water into planted basins with street trees, for storage and irrigation. Further case studies then explore various techniques for retrofit interventions to adopted streets elsewhere in White City that deliver SuDS and public realm improvements, including traffic calming and green infrastructure.

Importantly, wider use and adoption of concrete block permeable paving (CBPP) will enable developers and local authorities to meet the need to replace impermeable surfaces in both new developments and existing settings, in line with the 'sponge cities' paradigm. These requirements were highlighted in the 2022 National Infrastructure Commission report on surface water flooding and 2023 Defra report on implementing mandatory SuDS for England.

Understanding Permeable Paving

With more than 25 years' use on a wide range of project typologies, including adopted roads and even container terminals, CBPP has proven to be a robust, resilient and adaptable technology. It provides an attractive, safe and puddle-free surface for pedestrians and traffic, combining a structural pavement with integral drainage and no gullies.

Utilising a range of innovative techniques – demonstrated in these and other MPA Precast case studies – CBPP can be used to deliver low-cost, retrofit SuDS. This approach can be applied across regeneration projects, paving asset renewal and street upgrades, providing improved urban realm, sustainable street trees and other benefits – in addition to addressing surface water flooding and pollution at source.

The key to CBPP is its permeable surface zone of high-strength concrete blocks with angular aggregate used to fill enlarged joints and as a laying course. It allows water to pass between the blocks while filtering out silt with many pollutants – particularly the 'first flush' following rainfall – and preventing ingress of debris, retained on the surface where it can easily be removed. It can then deliver a gradual flow of clean water for safe SuDS, irrigation, biodiversity, reuse or discharge. This unique permeable surface works in conjunction with various construction profiles and differentiates the technology from other types of 'pervious' paving.

In most CBPP constructed to date, water passes from the surface zone into voids within an underlying coarse grade aggregate permeable sub-base, combining structural support and water storage. Increasingly, however, alternative structural layers are being used to create exciting opportunities for urban trees and green infrastructure, provide additional water storage, accommodate statutory services or meet other requirements. They include: structural soils, preparatory tree pits, geocellular systems and impermeable sub-bases. Also, retrofit permeable surface zone overlays, utilising existing road-bases (and their embodied carbon), offer particularly effective street renewal and regeneration solutions.

More information is available in the *'Understanding Permeable Paving'* guide available at www.mpaprecast.org

Bridget Joyce Square

Designed by SuDS consultants and landscape architects Robert Bray Associates (RBA), in conjunction with McCloy Consulting, Bridget Joyce Square introduces the innovative concept of concrete block permeable paving (CBPP) overlays regenerating existing impermeable paving.

This low-intervention, thin overlay technology enables sustainable reuse of conventional road bases and their embodied carbon, creating attractive, safe shared-surfaces, capturing rainwater runoff straight from the surface without gulleys. Permeable paving overlays can then provide a gradual flow of clean water laterally into raingardens or basins, for storage and irrigation. It can also be applied as a simple street renewal, running kerb-to-kerb to form a shared surface level with the footway and flush kerb top, and can simply optimise the original drainage regime – but below the surface.

In addition to exploring the design of this important project, following a site visit some 5-years after completion this case study also highlights the impact of CBPP overlays as an irrigation source, sustaining street trees and green infrastructure.

The scheme won 'Winner of Winners' (the President's Award) as well as Winner of the 'Adding Value through Landscape' category at the 2017 Landscape Institute Awards, and also an ICE London Civil Engineering Award 2016.

> ***" An exemplary approach to partnership working in delivering solutions to so many problems in a way that can, and should be, replicated nationally "***
>
> *The Landscape Institute judges*

Community Driven Regeneration

In 2013, the head teacher of Randolph Beresford School and the White City Residents' Association approached the London Borough of Hammersmith & Fulham. They recognised that the road in front of the school was unsafe and unhealthy, and identified the need for a public meeting space where events could be held. Coincidentally, the Borough was looking for a landmark retrofit SuDS project at that time.

Consultation with local people and a realization of the potential for the site led to an integrated design that linked two disconnected spaces and created a social arena celebrating rainfall. CBPP was used to break the existing formal road alignment and introduce a 'piazza' within the Bridget Joyce Square.

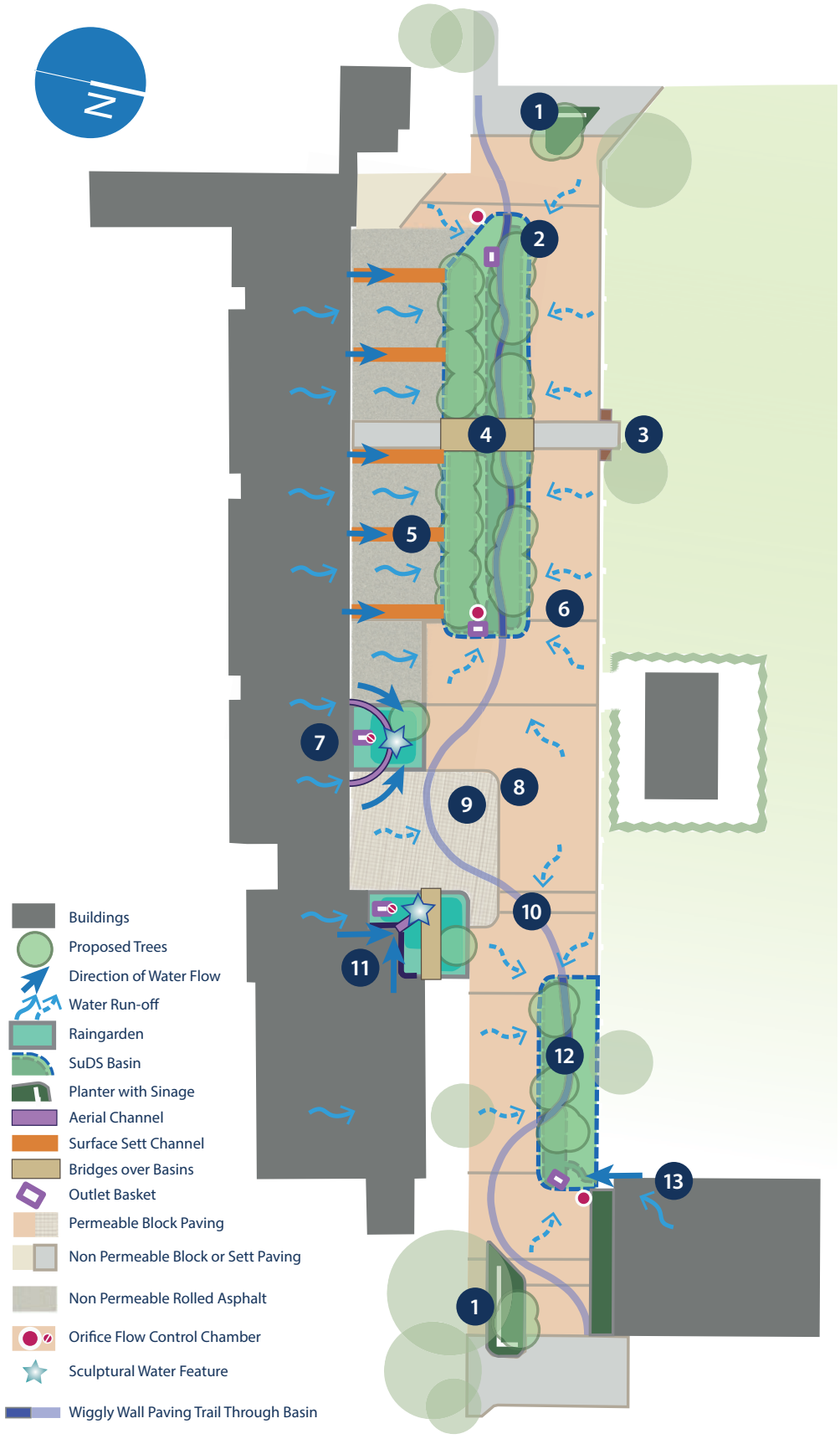
The scheme also connected the Randolph Beresford Early Years Centre to an adjacent play area and generated a social hub for parents and children. Local residents were keen to retain memories of the low wall in front of the school, used as a balance beam in their youth. From this the thematic 'Wiggly Wall' was born and became part of a 'ribbon' motif that united the linear spaces and symbolised the bringing together of the community.

Most importantly, it has been enthusiastically welcomed by local residents, as recognised by a Sustrans community survey. Ben Addy, Head of Collaborative Design, Sustrans, considered the project to be: *"a fantastic example of a Healthy Street. One that encourages walking and cycling, creates opportunities for play and socialising, and tackles a pressing need around water management and urban greening."*

" I can't think of a better example of where a local authority has to do some work and they actually come to a community, learn from the experiences of that community and actually put in place things that are absolutely, directly responsive to the needs of the community"

Harry Audley, Chairman of the White City Residents' Association

Design Strategy
Layout Plan



1 Prominent gateway features create a sense of entrance into a new space. A change of paving signals the pedestrian realm.

2 The main planted basins feature the 'wiggly wall' weaving between Birch trees and tall grasses. Each of the two basins stores rainwater collected from the surrounding permeable paved areas and the school roof and releases it slowly to the sewer.

3 New gateway allowing access directly from the park to the playground.

4 SuDS Basin 1.

5 Surface sett channels take rainwater from the downpipes and carry it to the main basin.

6 Paved areas are permeable, collecting and cleaning rainwater before conveying it to the basins via the subbase layer.

7 Raingarden 1.

8 Main plaza.

9 The school entrance is more open and welcoming with permeable paved area, bench seating and rain sculptures bringing rainwater down from the school roof to the flowering raingardens

10 A natural stone paving feature weaves through the park providing visual interest and a fun trail for children to follow.

11 Raingarden 2.

12 SuDS Basin 2.

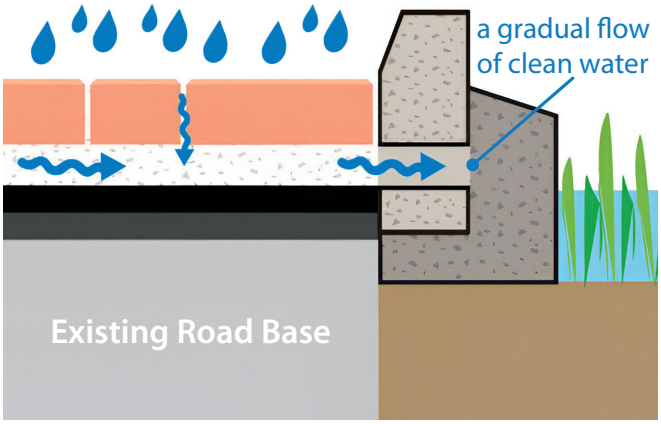
13 Adventure playground building.

SuDS Design

The SuDS landscape celebrates roof water collection with sculptural gutters, downpipes and twisted steel halyards bringing water into planted raingardens. Some roof water, together with car park runoff, flows along sett channels and through stainless steel letterboxes into planted basins.

The concrete block permeable paving overlay simply replaces a tarmac road surface over the original road base. The same blocks and 2-6mm grit bedding layer and jointing material as used in permeable pavements generally are here installed over a geo-composite conveyance sheet and transport water horizontally, on an impermeable membrane covering the road base. Water is attenuated and treated within the paving, then released horizontally via stainless steel letterbox slots into the planted basins.

The basins provide the required SuDS water storage, to avoid overloading the existing sewer, as well as irrigation. Finally, two flow control chambers on outlets from the basins protect the combined sewer, allowing water to flow from the site at 1 litre/second through 20mm orifices. Thus, rainfall remains within the SuDS landscape until storms have passed and the sewer can deal with water again.



Water is transported via the bedding course below the CBPP into the basin

Sculptural metal elements at high level feed roof-water into raingardens.

Water from the CBPP simply discharges horizontally into the planted basins through slots in the side-walls.

The original road surface has been replaced with attractive, 'self-draining' concrete block permeable paving. Clean water from the permeable paving passes into the planted basins. The 'wiggly wall' feature meanders through both paving and planting.

Permeable Paving and Street Trees

The project was revisited in August 2021, around 5 years after completion, and it was noted that the permeable paving was performing well and, it is understood from local sources, experienced no problems during recent extreme summer storms, despite extensive flooding nearby. Tests (in accordance with ASTM C1781) were also carried out demonstrating that all the water infiltration rates of the permeable paving were more than double those required by 'The SuDS Manual' (CIRIA, 2015).

The trees and other green infrastructure were healthy, substantial and particularly well-established. Robert Bray Associates founder, SuDS expert and landscape architect Bob Bray commented:

'All the plants have grown really well. Birches are particularly sensitive to drought and urban heat island effect but they have thrived here and the vegetation has remained green all summer. The critical thing seems to be that even small rainfall events are captured by the permeable paving in summer to benefit trees in the basins'.


2021


Before development


2016 regeneration complete


2021


2021 green infrastructure well established

The Wider View

This project has important implications for the delivery of measures to address climate change. The December 2023 'National Planning Policy Framework' (NPPF) states: *'Planning policies and decisions should ensure that new streets are tree-lined and that opportunities are taken to incorporate trees elsewhere in developments'.* However, measures are needed to nurture and allow trees to mature and deliver their real potential – including net carbon storage, urban cooling through shading and evapotranspiration, biodiversity and public wellbeing. So, the NPPF also requires that: *'appropriate measures are in place to secure the long-term maintenance of newly-planted trees, and that existing trees are retained wherever possible'.*

CBPP offers unique opportunities to collect, store and treat rainwater runoff, removing pollutants before irrigating green infrastructure. It also simply allows air to reach tree roots and poisonous CO_2 to escape. Local planning authorities now need to incorporate long-term tree maintenance measures in their planning consents and, as a straightforward spatial measure, CBPP offers a reliable, sustainable and multifunctional solution.

White City

Also designed by Robert Bray Associates, the White City project is an exemplar of straightforward, low intervention street renewal techniques, delivering SuDS and public realm improvements for traffic calming and green infrastructure, including both new and existing tree sustenance.

Following on from Bridget Joyce Square, swales for roof-water management were added to green spaces between residential blocks, suggesting an 'off-grid' surface water drainage approach to the whole estate, disconnected from public sewers. In 2019, RBA were asked to explore potential retrofit interventions to adopted streets. A series of suitable locations were identified along Australia Road and Bloemfontein Road, and designs developed.

The two roads are quite different in character, informing different applications of CBPP and SuDS techniques. Although complementary to the Bridget Joyce Square project located on Australia Road, the designs are more modest and limited to the highway. The completed First Phase works are discussed here.

Permeable paving parking bays include provision for electric vehicle charging

Excess water is discharged from the raingardens to the sewer via infiltration and overflow pipes

Raingardens between permeable paving areas incorporate new tree planting with long-term, passive sustenance

Australia Road

Effectively defining the perimeter of the estate on three sides, Australia Road forms a loop, joining Bloemfontein Road at two locations. The completed Phase 1 North and South sections of Australia Road are shown here. The Bridget Joyce Square regeneration occupies the remainder of the South section. The Phase 2 design covers the East section and remainder of the North section.

A quiet road with extensive on-street parking, it is residential in character with existing mature trees and open, green spaces (some incorporating swales) around apartment blocks. RBA's approach to introducing SuDS and additional green infrastructure involves the partial replacement of existing impermeable paving with CBPP to one or both sides of the road, avoiding statutory services and demarcating on-street parking areas, including some with EV charging points.

The existing road profile directs water from the impermeable asphalt carriageways over flush kerb restraints, together with runoff from footways, onto the CBPP (which can accept twice its own area of runoff). Raingardens created with granite detailing – some also with tree planting – are strategically located along the CBPP parking zone.

Australia Road (south) with Bridget Joyce Square beyond

Direct surface inlets from the asphalt and overflow routes for the permeable paving discharge into the raingardens

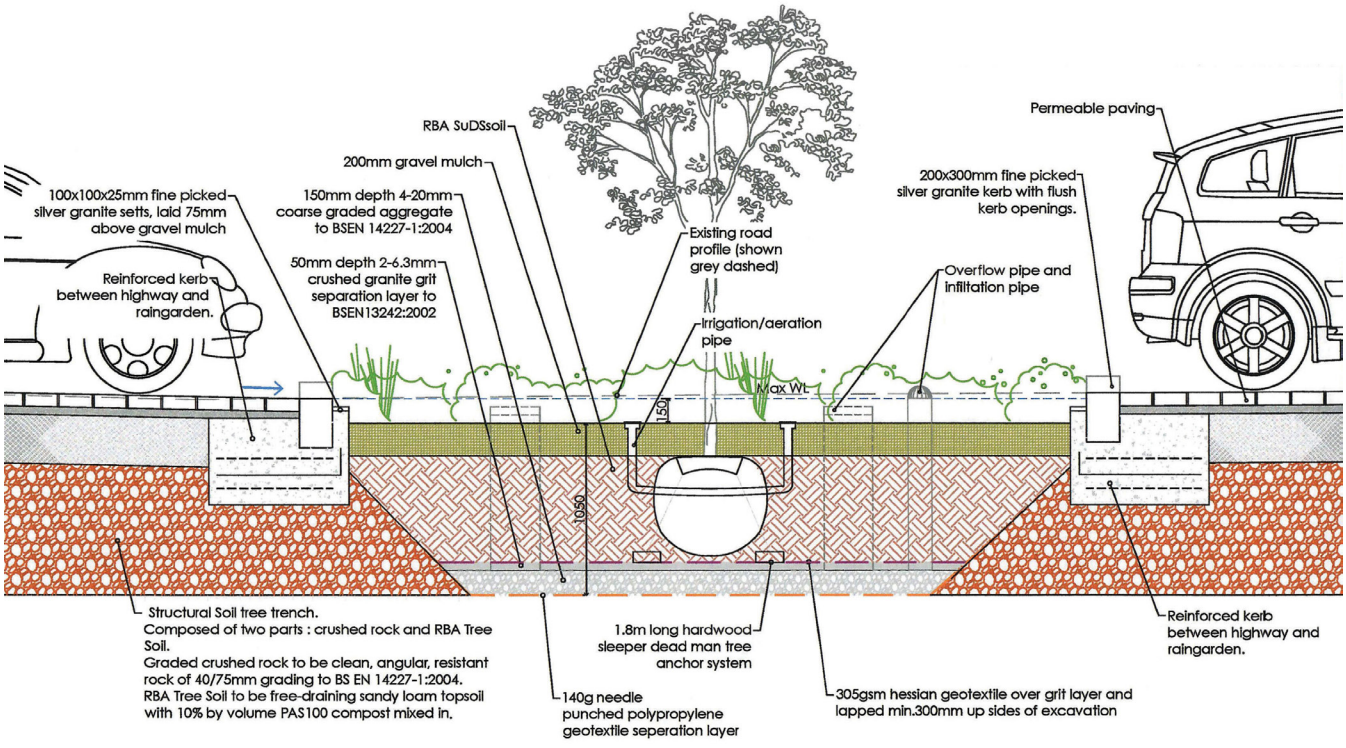
Green infrastructure is sustained by water runoff from the carriageway as well as from the CBPP

Street Tree Sustenance

Water storage for SuDS and conveyance to raingardens, providing sustenance for trees and green infrastructure, is achieved with a structural soil 'tree trench' below the CBPP surface zone, enabling long-term tree root growth. The CBPP surface also provides essential air/CO_2 exchange for roots and avoids surface disruption – not just for newly-planted trees but also for the mature specimens previously suffocated by sealed surfaces.

Direct surface inlets from the asphalt, and overflow routes for the CBPP, discharge into the raingardens where water is also stored and treated. Following attenuation, natural losses and treatment, remaining excess water is discharged from the raingardens to the sewer via infiltration and overflow pipes.

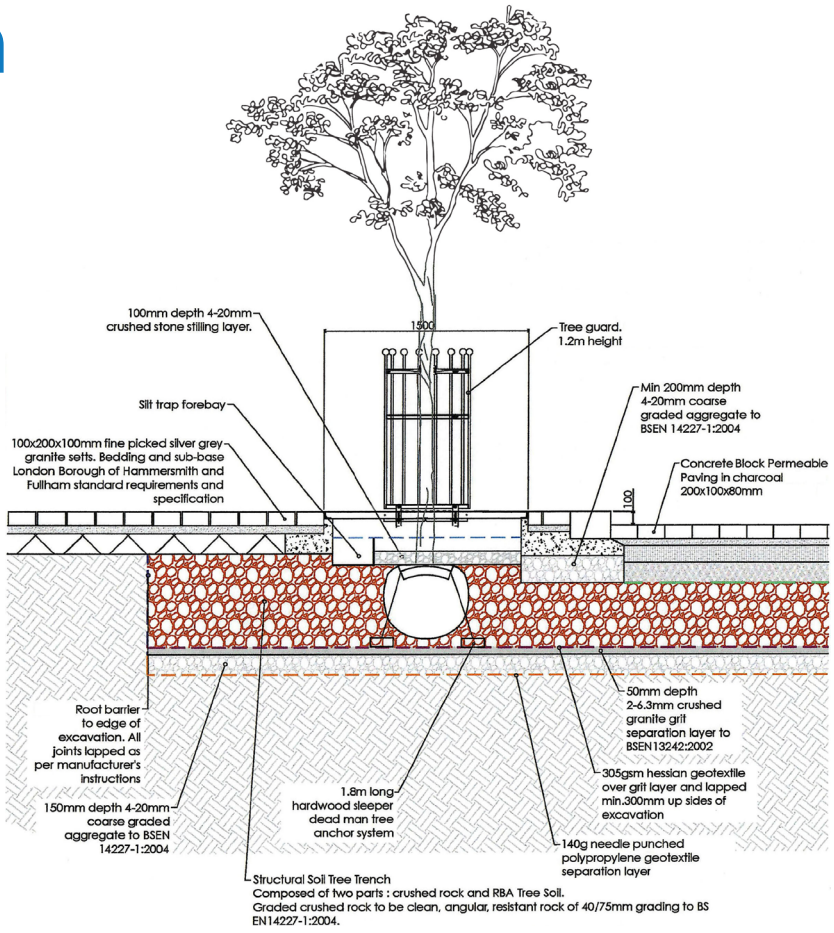
Mature trees previously suffocated by sealed surfaces… can thrive again with permeable paving



Typical section through structural soil tree trench with tree pit

Bloemfontein Road

A more heavily trafficked street along the western edge of the estate, Bloemfontein Road also incorporates a 'service road' running parallel and fronting local shops, separated by an inhospitable, wide reservation. With low-intervention paving improvements, this service road has now been transformed into a pedestrian friendly shared surface. It is set level with the shops, while retaining vehicle parking and access, and has potential for an open market or other community uses.



Typical section through structural soil tree trench with tree pit

The shared surface serving local shops is separated from the busy main road by a footway

Panels of asphalt, interspersed with concrete flag paving, some incorporating seating, and flush kerb delineation – all drain onto CBPP car bays with no gulleys. The main road footway retains its stepped kerb and incorporates street trees, some in build-outs within the CBPP parking zone. Again, a structural soil 'tree trench' sub-divided by baffles, below the CBPP surface zone enables street trees – even when extensively surrounded by hard surfaces – to thrive and develop.

New tree planting is sustained by water from the permeable paving as well as impermeable surface runoff

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