Addendum to Tree pits and Green Roof.

1.0 Introduction

Condition 4. states that ***"prior to commencement of development, full details of the sustainable drainage systems including attenuation tanks at least 37m3, permeable paving, tree pits and green roofs, shall be submitted to an approved in writing by the Local Planning Authority"***

We have submitted the latest revision of the Sustainable Drainage Systems (SUDs Strategy), Document No. L2658-REP-SUDs-003, (attached) and previously drawings;

L2658-C-52-7000 Drainage Layout
L2658-C-52-7001 Drainage Layout
L2658-C-52-7100 Drainage Detail
L2658-C-52-7200 Drainage Detail page 2

The attenuation tank has been increased in size to 37 cubic metres, and the system has been designed to accommodate all storms up to and including a 1:100 year storm with a 40% provision for climate change, whilst resulting in no more than the approved 2.0l/s run off rate.

The purpose of this addendum is to provide additional information on *'tree pits and green roofs'.*
PJCE, our drainage engineer, has stated that there is no need for additional Stormwater Control Measures (SCMs), given that based on the attenuation tank alone we meet the condition requirements. But I understand that there is a benefit in providing additional SCMs, such as Tree pits and green roofs.

2.0 Tree Pits.

2.1 Research

Stormwater tree pits and green roofs form part of our 'whole water management network' at 2 Templewood Avenue, contributing to the reduction of the rate of surface water run-off from the building and thereby limiting the impact on the storm water drainage system in accordance with policies CC2 and CC3 of the London Borough of Camden Local Plan Policies and Policy SI 13 of the London Plan 2021.

Stormwater Planters

* Reduces flood risk by diverting water from drains and swedes
* Filters, cleans, stores and slowly releases rainwater run-off.
* Increases biodiversity & reduces pollution.
* Provides storage in times of drought.
* The soil absorbs the stores the rainwater for plants to use. (Bioretention).

Tree pits are an attractive 'stormwater control measure' (SCMs), because of their small footprint, potentially low cost and the co-benefits they bring through improved tree growth.

They provide the trees with passive irrigation, and achieve a meaningful reduction in storm water runoff. It has been recently demonstrated that they can achieve a 90% reduction in annual runoff, and to reduce days of runoff to just 15 days / year. *

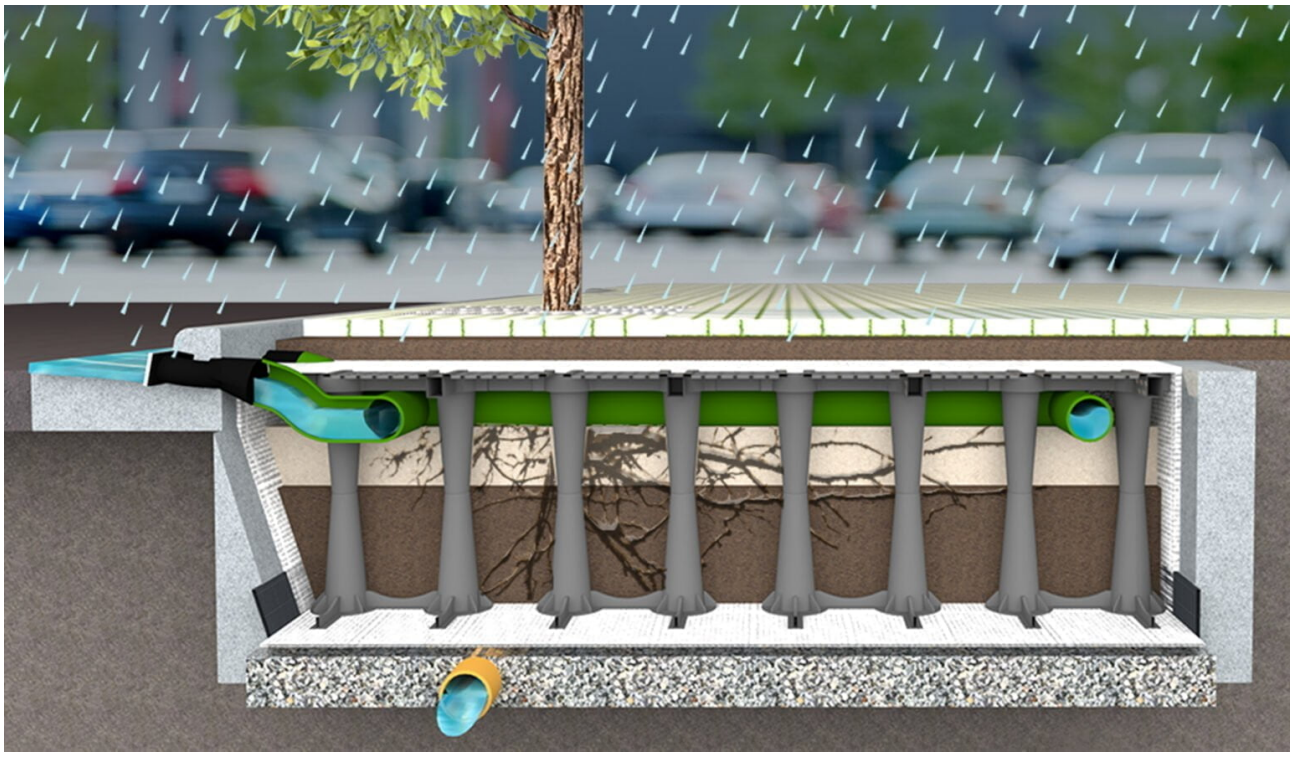
* *Journal of Hydrology, Volume 565, October 2018, Pages 400-410*

However due to the limited catchment area, they work best alongside a suite of other complimentary SCMs, such as the permeable paving, attenuation tank and green roof, as proposed at 2 Templwood Avenue.

There are several types of stormwater tree pits, such as the 'Stratacell tree pit', where stormwater is filtered through 'Aborsoil Hydro soil medium' which removes most of the pollutant loading, and the water is slowly returned to the combined sewer via a 'control orifice'.

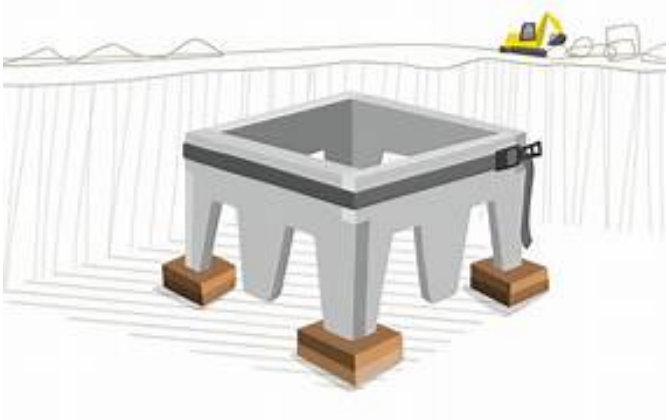
For up to a one-in-ten year rainfall event, the water returns to the combined sewer at a Greenfield runoff rate, massively helping the sewer network. Taken together with the iota SCMs (Typically only 50% of the water that enters the SUDs system ever reaches the sewer system, as the tree uses water and and the attenuation tank controls the runoff rate.)

Other types of tree pits include, ‘Strataflow’, an advanced structural soil cell system installed easily under the permeable paving, again enabling stormwater to be stored, filtered and distributed effectively for the benefit of urban trees.



There are many examples of ‘Stockholm’ tree pits that have recently been built in London.

The Stockholm tree pit consists of a simple interlocking concrete frame, that provide the pit for the tree to be planted in, within a soil classed as a structural soil.



A structural soil is made up of clean stone, compacted, with a soil mix added. The result is a network of interconnected voids between the stones. These void spaces provide opportunities for root growth, air diffusion and water movement.

Structural soil replaces the typical 'Type 1' compacted aggregate more normally associated with sub -base for pavements and roads.

A structural soil can accommodate more water than loam soils and provide the aeration required for vegetation, all of which contributes to the SUDs schemes by reducing peak flows and the volume of runoff.

The structural soil is also more flexible and can easily replace the existing soil in irregularly shaped planting pits, rather than being limited to the crate like rigidity of attenuation tanks (as used under the permeable paving.)

A further advantage of using structural soils in and around tree pits is that aeration level provides much needed soil aeration which benefits plant growth. The use of 'enriched biochar' in the soil mix is another key innovation because it improves the water holding capacity of the soil and provides better nutrient availability.

2.2 Proposal for 2 Templewood Avenue

Condition 8 / 9 states that ***"No development shall take place until further details of hard and soft landscaping including details of at least 8 replacement trees… have been submitted and approved".***

Therefore one might assume that there is the potential to create 8 tree pits. However the entire rear garden is within a tree protection area, due to the magnificent ancient Oak tree located centrally, and the paths, low garden walls and topography is all to remain as exiting.

The only two new trees in the rear garden are located next to the rear property line, Pleached Hornbeam (Carpinus Betulus), and will be planted directly into the ground.

In the front garden, we have 6 new trees being planted, Two directly in front of the house, two on each of the NE and NW corners, and two centrally located framing the proposed pedestrian gate. The trees are :

1 x Upright pillar crab apple tree
2 x Upright flowering cherry tree
1 x Ornamental pear tree
2 x Coral bark Japanese Maple Tree

The 37m3 attenuation tank is located under the permeable paving, and all six trees are located in planted beds to the front and rear of the driveway and pedestrian paving.

We plan to use the ‘Stockholm Planting pit’, within these planted beds, not only to benefit the new trees but also to add a further SCMs to the sustainable drainage system.

The catchment area will extend further than the simple planting pit, it will extend as far as the permeable paving, making the entire planted bed an effective ‘rain garden’, allowing all storm water to percolate through, benefitting the trees and shrubs. Any excess water can be directed within the sub soil area to the attenuation tank, adding to the water penetrating the permeable paving, and reducing the flow rate to the combined sewer.

The existing loam topsoil and clay groups below, will be dug out, to a depth of approximately 2.5 metres, and replaced with a structural soil, compacted with sharp gravel, retaining aeration holes and drainage.

A pipe will be connected from within the structural soil layer providing an overflow to the attenuation tanks that are located entirely to the underside of the permeable paving.

3.0 Green Roofs.

3.1 Research

Green Roofs comprise a multi layered system that covers the roof of a building with vegetation cover / landscaping. The roof is likely to consist of an impermeable layer, a substrate or growing medium and a drainage layer.

Green roofs are designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

They harvest water at source, encouraging gradual evaporation, evapotranspiration and the re-use of stormwater. In contrast to a traditional roof where the vast majority of rainfall falls off, rainwater landing on a green roof enters a complex hydrological system. The system retains water in vegetation, substrate and layered materials, thus providing runoff retention that allows for better stormwater management.

Rainfall entering green roofs is partly stored in the substrate and taken up by plants, partly returned to the atmosphere via evapotranspiration and partly discharged as runoff.

Benefits include;

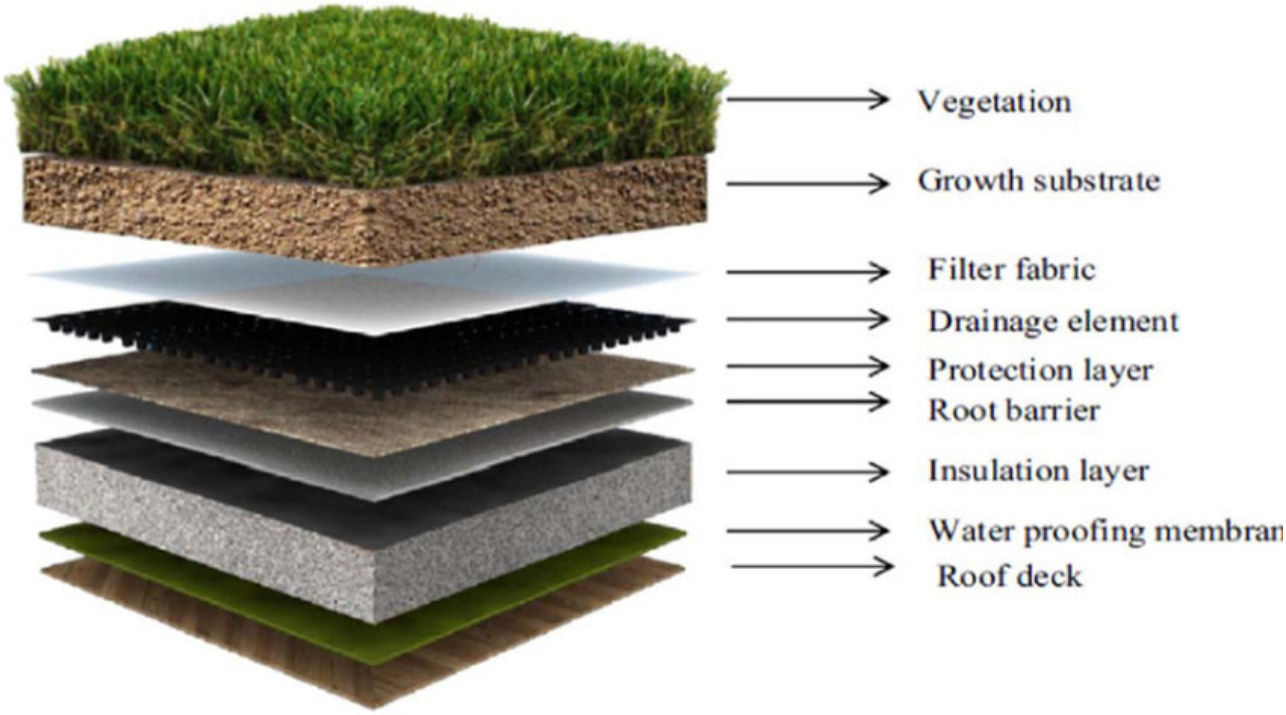
- reduce or eliminate run-off from roof areas
- extend the life of your roof
- add insulation to your building during the winter months
- cool your building during the summer by evaporation
- provide sound insulation
- reduce the heat island effect in cities
- provide a habitat for wildlife.

3.2 Proposal for 2 Templewood Avenue

We propose using a 'Team Urbanscape Retention Green Roof system'.

It can be installed on a relatively lightweight construction, it can be thinner than a traditional green roof system. The reduced thickness does not compromise the performance, therefore the same water absorption and retention are achieved.

The emergency run off from the green roof to prevent flooding will be directed towards the planted bed to the front of the house, which will effectively become a ‘rain garden’, allowing any surplus rain water from the green roof, to attenuate through the structural soil and drain to attenuation tank below the permeable paving.



An introduction to growing urban trees in structural soils

Large trees provide valuable ecosystem services and they are a key component of green infrastructure. Small trees provide only a tiny fraction of these benefits and so it is important that landscape designers provide suitable environments for trees to live long enough for them to deliver returns on the investment of planting and maintaining them in the early years of establishment.

A structural soil is a stone-based growing medium that can support pedestrian and vehicular traffic, and so their use allows tree pits to be extended beneath hard surfacing. This enables designers to provide enough soil for a tree to be healthy and reach maturity.

When designing tree pits with structural soils rainwater that has been collected from roofs, roads and paved surfaces is diverted into the tree pit. Trees grow extremely well in tree pits constructed in this way and the approach also contributes to stormwater management systems.

It's now possible to build tree pits with structural soils in the UK by using the products supplied by Stockholm Tree Pits and this practice note aims to explain how to do it.

Figure 1:
These trees are growing in a structural soil beneath a pavement. The long shoot extension and uniform growth of the avenue shows that all of these trees are very healthy.

CONTENTS

Tree pits beneath hard surfacing

Just as a potted plant can grow too large for the volume of soil in the pot, so can an urban tree reach a size where its growth becomes limited by the available root space. When the root system cannot increase in size any longer because the rooting space is filled to capacity, crown growth will slow and the tree will develop a stunted appearance. Water stress becomes more frequent and severe, which makes plants more susceptible to secondary disease and insect problems. When stress becomes severe, decline will begin. This is why it is common to see urban trees in poor health, and trees planted in hard landscaping often die young.

The typical street tree is situated in a narrow strip between the road and adjacent buildings and has to compete for underground space with a variety of utilities. Under these circumstances trees rarely have enough soil to allow them to grow to a size where they provide significant benefits. In order to solve this problem, there is a need to construct **submerged tree pits** that extend tree pits beneath areas that are used by pedestrians and cars. Specially engineered tree pits are required to create a functional rooting environment beneath a hard surface *(see Figure 2)*.

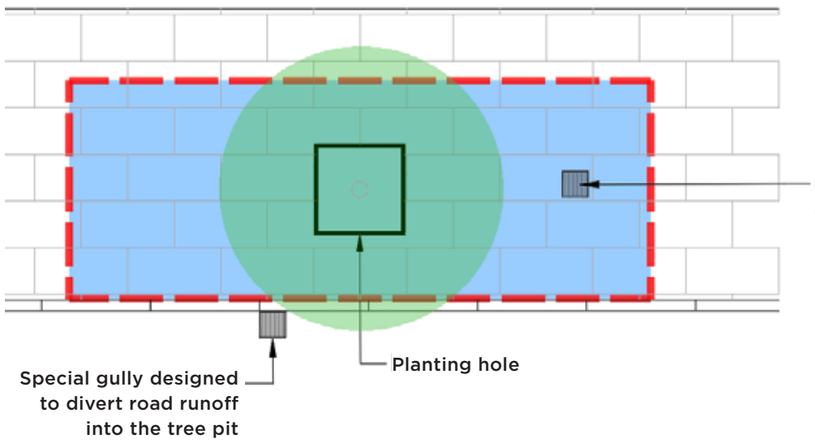


Figure 2: *The key elements of a submerged tree pit*

STOCKHOLM TREEPITS

+ ***Allow tree pits to be extended beneath hard surfacing –*** *Tree pits can be made larger so that street trees are provided with enough soil to live long and healthy lives*

+ ***Uses rainwater to irrigate the urban trees –*** *Water is diverted from aboveground into the tree pit where it can be taken up by tree roots*

+ ***The approach allows oxygen to reach the soil –*** *Roots need oxygen to respire and structural soils provide pathways for gaseous exchange between the soil and the above ground atmosphere*

Extent of submerged tree pit

Surface area of tree pit

What are structural soils?

A durable road or pavement needs a solid base. The traditional method to constructing a reliable surface is to dig down to nearly a metre and install a sub-base with aggregate ranging in particle size from about 100mm down to dust. These aggregates are highly compacted to meet load-bearing requirements and engineering standards. This often stops roots from growing, causing them to be contained within a very small usable volume of soil without adequate water, nutrients or oxygen. A typical tree used for street planting needs a root volume of at least 20m^3 (and preferably a lot more) at maturity (say 50 years) but often the hole dug in the pavement to form a tree pit less than 2m^3. Trees planted this way will suffer from ill health and won't make it to maturity. Furthermore, because the roots can't enter the hard-packed base they often grow into the thin layer of coarse sand beneath the surface and cause trip hazards by lifting the pavement.

This new approach, which has been evolving in Europe and the USA for some years, is now rapidly gaining ground in the UK. It involves the creation of a stone-based **'structural soil'** which can be compacted to provide a solid base for surfacing while allowing large voids to remain for water movement, air diffusion and tree root growth. Structural soils can meet engineering standards for supporting pedestrian and vehicular traffic whilst at the same time providing enough soil for a tree to be healthy and reach maturity. The design encourages roots to grow deep underground and so they don't lift the pavement. The tree planting programme carried out by the City of Stockholm has demonstrated that exceptionally healthy trees can be cultivated when using structural soils.

Figure 3:
Most of a structural soil is made up of clean stone. After the stone has been compacted, and a soil mix added, there remains a network of interconnected voids between the stones. These void spaces provide opportunities for root growth, air diffusion, and water movement.

STOCKHOLM TREEPITS

+ ***Provides a solid foundation –*** The compacted stone that makes up the structural soil meets the necessary engineering requirements to support a load-bearing surface

+ ***Prevents surface rooting –*** The design ensures root growth happens deep below the surface and so footpath disturbance is avoided, and future surface maintenance requirements are minimised

+ ***Easy to install –*** The components of structural soils are easily available and can be installed using standard construction machinery

+ ***Tried and tested -*** Structural soils have been proven to be a cost-effective way to provide for the needs of both engineers and trees

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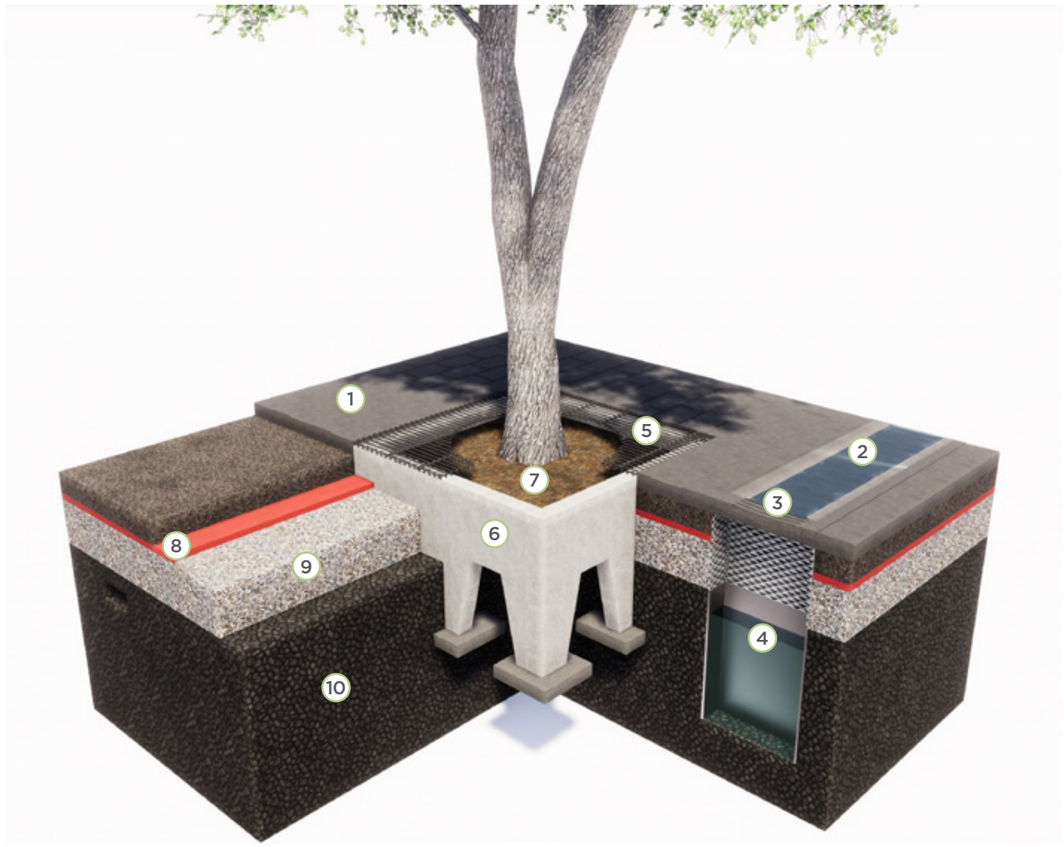
The Stockholm system (structural soil with biochar)



[Image courtesy of Davies Landscape Architects]

Diagram notes:

1 Standard paved surface with base course (this does not need to be permeable)

2 Channel to divert rainwater into the tree pit

3 Inlet/gully grate for water ingress and gaseous exchange

4 Aeration well with silt trap (available from www.stockholmtreepits.co.uk)

5 Tree grille

6 Concrete frame (available from www.stockholmtreepits.co.uk)

7 The concrete frame is filled with topsoil

8 Separation geotextile

9 Aeration layer, this is a 200mm layer of 20-40mm clean stone. Water from the inlet(s) is also distributed through this layer.

10 Structural soil is made up of 32-63mm clean stone combined with a 1:1 mix of enriched biochar and compost (15% volume)

The SuDS benefits of structural soils

In most built-up areas rainwater is diverted away from the trees into storm attenuation systems, but this is a waste of an important resource because the local street trees would benefit from receiving that water. This Stockholm system collects rainwater from roofs, roads and paved surfaces and diverts it into the tree pit. This type of tree pit design serves the soil's need for oxygen by incorporating large inlets that provide pathways for gaseous exchange and water ingress. An aeration layer of clean stone is included between the paved surface and the structural soil, this aeration layer is linked to the inlets to allow air and water to reach the whole of the tree pit. The inlets are deliberately designed to be at the low point of hard surfaced areas so that they receive as much rainwater as possible. Runoff from the roads can also be diverted into the tree pits using roadside drains *(see Figure 4)*. Therefore, trees planted in this way contribute to Sustainable Drainage Systems (SuDS). Urban trees provide all the functions associated with SuDS, including the interception and storage of rainfall at source, the filtration of pollutants, the provision of amenity, and supporting local wildlife. Studies have found that access to stormwater increases the growth rates of street trees during the establishment period compared to traditional street tree planting techniques. **In the modern age stormwater management and urban tree establishment should be part of one integrated design.**

Figure 4:
An example of a street where road runoff is being diverted into a submerged tree pit via a kerbside inlet.

STOCKHOLM TREEPITS

+ ***Managing rainfall close to source –*** *The leaves of the trees can intercept rainfall before it hits the ground, and the transpiration of the trees also removes water from the drainage system before it leaves the site*

+ ***Stormwater attenuation –*** *Allows the water retention capacity of a new development to be increased and so reducing volumes of runoff discharged to receiving waterbodies and sewers*

+ ***Source control –*** *Tree pits function as a source control for water-borne pollutants by degrading or immobilising contaminants that pass through them*

+ ***Amenity benefits –*** *Large urban trees provide significant public amenity, they bring obvious visual appeal to many urban landscapes and their leaves can intercept airborne particulates that are harmful to human health*

+ ***Habitats for wildlife –*** *Urban trees bring wildlife benefits by providing habitats for a wide range of other organisms*

+ ***Increased growth rate –*** *Trees that have access to stormwater grow more quickly and are less likely to suffer from drought stress*

Advantages of structural soils over crate systems

Modular plastic structures (crate systems) or structural soils can be used to support surfacing above tree pits. Both systems are a good way of growing healthy urban trees but structural soils are more versatile because they can be installed around existing underground structures whereas crate systems need to be installed in a rigid geometric shape. Also, crate systems are difficult to dismantle and reassemble if they ever need to be moved but structural soils can easily be dug up and reinstalled if any underground maintenance works are required.

The biggest advantage that structural soils have over crate systems is that they are much cheaper to install. Structural soils also accommodate more water than loam soils and so they can contribute more to SuDS schemes by reducing peak flows and the volume of runoff. There are additional environmental benefits because crate systems involve the use of large quantities of plastic, and their use risks spreading micro plastics into the environment downstream. Furthermore, the materials used for structural soils are more sustainable than plastic crates because the stone, biochar and compost can all be made of recycled material.

When comparing the two approaches the manufacturers of the plastic crate systems will cite old studies where trees planted in crates performed better than structural soil mixes. However, there have recently been significant innovations in the design of tree pits for structural soils. One important new design feature is the introduction of the aeration layer. Soil aeration is an important factor in tree growth and tree pits designed for structural soils now cater for this need better than any other technique. The use of enriched biochar in the soil mix is another key innovation because it improves the water holding capacity of the soil and provides better nutrient availability.

STOCKHOLM TREEPITS

+ ***Structural soils are cheaper to build than crate systems –*** *Allowing the landscaping budget to stretch further*

+ ***Free from plastic –*** *Crate systems require lots of plastic material but structural soils do not*

+ ***Sustainable –*** *Structural soils can be made of recycled materials*

+ ***Ecological –*** *Biochar provides habitats for soil microbiota*

Constructing tree pits with structural soils

A pre-cast concrete planting frame is used for the planting hole to house the rootball. This also functions as a root deflector by ensuring that roots can only grow deep beneath the surface. The concrete planting frame has rigidity which allows stone to be introduced and compacted around the planting hole during the construction of the tree pit. The frames are either 1m² or 1.2m² which means that a standard tree grille can be fitted above.

The similar-sized stones are installed in layers and once the material has been laid it is effectively a macadam[1] sub-base. The best results are being achieved by using clean stone combined with a 1:1 mix of enriched biochar and compost (15% volume). Specifiers should be aware that the stone fraction of the soil mix fills the tree pit and that the biochar/compost mix adds nothing to the overall volume of the soil because it fits into the void spaces between the stones.

Biochar is produced through pyrolysis (burning at 350 to 800 under partial exclusion of oxygen). The resulting material is durable and its large surface area has a high affinity for nutrients. Adding biochar to soils directly sequesters carbon and produces soil that have a high carbon content. There are a variety of ways that biochars improve soils and these include reducing the bulk density, enhancing soil aggregation, improving the water retention capacity of the soil and reducing leaching of trace metals from the upper horizons of the soil profile. It also has excellent filtration properties which remove waterborne contaminates. Another benefit of biochar's structure is that it provides micro-habitats for soil organisms.

Figure 5:
A structural soil tree pit in the process of construction. Here larger stones are being used so that the final surface will be able to support heavy traffic.

[Photograph courtesy of Björn Embrén]

[1] Macadam is a type of road construction in which single-sized layers of small angular stones are placed in shallow lifts and compacted thoroughly.

PRODUCTS AVAILABLE

Concrete planting frames and steel aeration wells and biochar are available to buy from www.stockholmtreepits.co.uk

Specifications for these products can also be downloaded from the website

MATERIALS CALCULATOR

Download the spreadsheet from the Stockholm Tree Pits website to calculate the materials that you require for your project.
stp-materials-calculator.xlsx

Constructing tree pits with structural soils

The load bearing element of the structural soil needs to be a hard angular stone such as crushed granite, basalt or recycled concrete that has been screened to remove fines, for most installations this will be 32-63mm clean stone. Crushed limestone can be used in the structural soil mix but it influences the soil pH and so only alkaline tolerant species should be planted in this scenario. It is recommended that the stone is mixed with the biochar/compost mix before being installed. Larger stones (40–75mm) are used for roads because they can support heavier loads. When the larger stones are used the biochar/compost mix should be hosed into the void spaces after the stones have been compacted.

The top 200mm beneath the surface courses is clean stone (20–40mm), and this layer provides pathways for air and water to reach the whole of the extended tree pit via the aeration wells. The aeration wells are installed within the structural soil mix, they receive rainwater from the hard surfacing above; they also trap any silt and debris that is washed down with the water.

Impermeable tarmac or **any sort of paving can be laid on top of tree pits constructed using the Stockholm system.** A geotextile is laid over the entire tree pit followed by a base material for the pavement and the surface layer for the specific paving of the road, pavement, or cycle path to be installed. The membrane prevents the surface's base material from migrating down into the aeration layer and it also prevents roots from growing up into the base material. In this way the aeration layer ensures that root growth is well below the final surface and so problems caused by roots lifting pavements are avoided.

Standard machinery found on most building sites can be used to install structural soils. Also, the low-tech approach means that the surface can be dug up after the pavement has been laid if any future ground works are required, and shallow underground services can be installed in the gap between the pavement and the tree roots below.

STOCKHOLM TREEPITS

Over 4000 projects using this approach have been completed in Stockholm, and after 10 years of monitoring tree pits created using structural soils the Swedish National Road and Transport Research Institute (VTI) now endorse the use of this tree planting technique.

Structural soils are an acceptable infill material for highway construction as defined by the Specification for Highways Works Volume 1, Series 600 – Earthworks. Structural soils fit the Class 6C specification and compaction requirements for such materials are provided in Table 6/1.

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Other types of structural soil

A stone-soil mix called CU-Structural Soil was developed at Cornell University in the early 1990s. Broadly speaking this mix is 80% stone and 20% soil by dry weight with a small amount of hydrogel to prevent the soil and stone from separating during the mixing and installation process. The stone component is highly angular crushed rock that ranges from 20mm to 40mm in size, with no fine materials. When this stone is compacted, friction between the stones at contact points locks them together. The compacted stone and soil mix has 26% void space for the storage and dispersal of air and water. The second component of the mixture is a clay loam soil that partially fills the void spaces between the stones. This mix is suitable for use below lightly trafficked areas such as cycle paths and car parks.

There is a large body of research that relates to CU-Soil and guidance for its use and installation is freely available. A particular advantage of using CU-Soil its precise composition allows designers to calculate how much water a tree pit will be able to hold.

Site specific structural soil mixes can also be made which may allow aggregate materials generated by demolition works to be recycled (e.g., crushed brick or concrete), provided that they are strong enough to support the required loading. Careful monitoring is required when recycled aggregates are being used to ensure that they meet the relevant specifications. Local soils can also potentially be used to provide the soil component of the mix, but these should be tested first because they may need to be amended before use. If a soil is not mixed properly it will not uniformly supply optimum growing conditions for the tree, and so quality management systems need to be put in place to ensure that the soils put into a tree pit have been mixed in accordance with the specification.

All of the materials required to create structural soil mixes are readily available, however mixing them and installing them requires careful oversight. Porosity is an integral property of structural growing media and so it is important not to completely fill the pore spaces with the soil component, i.e., it's better to add too little soil than too much.

STOCKHOLM TREEPITS

Structural soils are a low-impact solution for creating shared surfaces that allowing the long-term survival of trees in streets, car parks, and plazas.

FURTHER READING

Embrén, B. (2009).
Planting Beds in the City of Stockholm, A Handbook.
City of Stockholm.

Construction Industry Research and Information Association (2015).
CIRIA 753: The SuDS Manual.
CIRIA, London.

Trees and Design Action Group (2014).
Trees in Hard Landscapes: A Guide for Delivery.
TDAG, London.
.tdag-trees-in-hard-landscapes

Installing structural soils

The structural soil ingredients should be mixed on a flat surface using an excavator with a spreading bucket. Care must be taken to ensure that the soil mix retains moisture and consistency from the mixing point to its installation. In order to maintain a consistent mix the material should be covered if it is stored for any length of time to prevent any surface washing of the outer layer during a rain event.

The structural soil should be laid in lifts of no more than 250mm and spread with the excavator bucket. At each stage the fill should be compacted by a vibrating compactor plate.

Structural soils can be placed around underground services. The services can be protected from root ingress by wrapping them in a suitable geotextile or by installing them inside plastic ducting. Fragile pipes or infrastructure can be protected in the standard way by surrounding them with a pipe-bed gravel mix (4–10mm clean stone).

New tree pits can be created in existing streets by excavating a hole and then filling it with structural soil, and growing conditions can be improved around existing street trees by removing existing soil with a vacuum and replacing the soil around the root system with the stone/biochar/compost mix.

Mature Size of Tree

	Very Small (<5m)	**Small** (5–10m)	**Medium** (10–15m)	**Large** (15-25m)	**Massive** (>25m)
Recommended volume of **structural soil**	**8m³** (6m³ if shared)	**15m³** (12m³ if shared)	**26m³** (20m³ if shared)	**36m³** (28m³ if shared)	**45m³** (35m³ if shared)
Recommended number of **air/water inlets**	**1** (0.5 if shared)	**1** (0.5 if shared)	**1**	**2** (1.5 if shared)	**2**

STOCKHOLM TREEPITS

RESOURCES

The compost and the biochar fit into the void spaces between the stone and so they add nothing to the overall volume of the mix; so, for example 20m³ of structural soil would require 20m³ of clean stone and 3m³ of the biochar/compost mix. An easy-to-use spreadsheet to calculate the components required is available at **stp-materials-calculator.xlsx**

Designs for water inlets and aeration wells and PDF files of key reference texts are also available for download.

SOIL VOLUME GUIDANCE

Detailed guidance on the size of tree pits for different species is available from www.stockholmtreepits.co.uk

Drainage

Designers need to ensure that tree pits have adequate pathways for water ingress and to allow gaseous exchange between the soil and the above-ground atmosphere. This could be provided by installing a permeable surface over the whole of the tree pit or by using a non-permeable surface with specially designed inlets. Permeable surfacing allows rainwater and air to reach the soil directly from above but supplementary inlets to help them reach the lower levels of the tree pit are recommended. Suitable inlets would be substantially larger than an irrigation tube and service the whole of the tree pit. The surface should be designed to have inlets at local low points so that the tree pits receive as much rainwater as possible, the planting hole can sometimes be used to collect surface water if it is designed to be highly permeable and lower than the surrounding surfacing.

Unless there is good drainage in the surrounding soil engineered tree pits need drainage included as part of the design in order to prevent the tree pit from becoming waterlogged. The tree pit drainage should be designed in such a way that the rainwater passes through the soil before it is drained out of the tree pit.

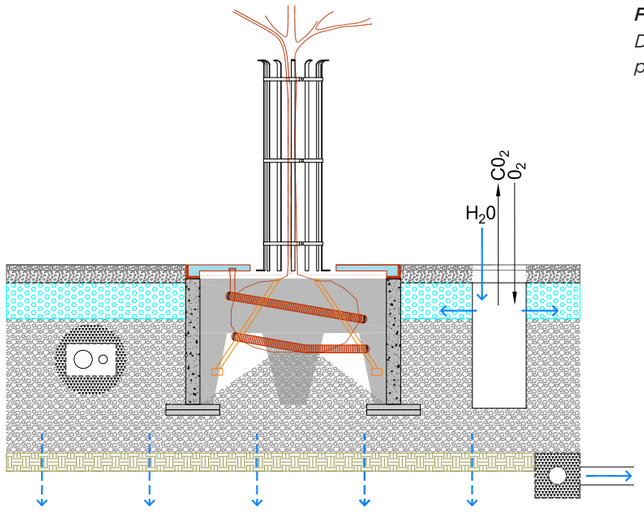

Figure 6:
Design for a submerged tree pit with structural soil.

STOCKHOLM TREEPITS

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If you are interested in purchasing our products and would like to speak to someone in our sales team, please call us on **07872 609 633.**

Alternatively send an email to **enquiries@stockholmtreepits.co.uk**

RESOURCES

CAD diagrams for the design of tree pits with structural soils are available from **www.stockholmtreepits.co.uk**

Designs for water inlets and aeration wells and PDF files of key reference texts are also available for download.

Summary

Typical urban soils are very unlike natural soils and so tree planting sites need careful design in order to support healthy and long-lived trees. In the past the lack of understanding of the tree's requirements has led to them being planted with inadequate soil volumes; ultimately this results in urban trees having short lives and only providing a small fraction of the benefits that they could potentially be bringing to towns and cities.

With competing demands for space in the modern street we need to be creating submerged tree pits that can support pavements whilst allowing tree root growth beneath. Structural soils are one of the simplest solutions to this problem because they can support heavy loads and simultaneously provide soils suitable for root growth. If structural soils are to be used they need to be installed in engineered tree pits and the tree pits have to be designed provide adequate water infiltration, drainage, air diffusion, soil, and nutrients to support the tree into maturity. By installing structural soils beneath pavements and car-parking spaces designers can provide enough soil for an urban tree to reach a degree of maturity that will deliver returns on investment by providing benefits to local communities.

Stockholm Tree Pits can supply the concrete planting frames and the aeration wells required to construct the tree pits. Stockholm Tree Pits can also supply Carbon Gold Tree Soil Improver biochar in bulk and at a discounted rate. This is an enriched biochar that improves soil structure and is proven to boost the health and vitality of trees.

CONSULTANCY SERVICES

Stockholm Tree Pits specialises in the design of urban tree pits and offer this as a consultancy service. We can assist in all stages of a project, from initial masterplanning through to detailed design and the supervision of tree pit installations. Please get in contact if you have any questions about how to design or construct tree pits using structural soils.

We are here to help, call us now on 07872 609633
or email enquiries@stockholmtreepits.co.uk

STOCKHOLM TREEPITS

There are three key factors that tree pit designs need to include:

***Soil volume** – Designers need to specify enough soil to support the tree at its mature size*

***Water** – Trees need a continual supply of water if they are to thrive. In the urban environment a tree's water supply can be naturally sustained if rainwater is collected and diverted into the tree pit*

***Air** – Roots respire in order to generate energy, and this process requires oxygen. Therefore, pathways need to be provided for gaseous exchange between the soil and the above ground atmosphere*

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