TREES AND WATER SENSITIVE URBAN DESIGN

URBAN TREES – AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT?

A presentation by GreenBlue Urban

GreenBlue® URBAN

The Evolution of Urban Stormwater Management

- The past 2000 years getting stormwater off site as quickly as possible.
- Combined sewers designed for less population and for more permeable surfaces.
- Many combined sewers now have inadequate capacity.
- Sewage treatment plants dealing with lightly contaminated water unnecessarily.

Stormwater Retention Onsite

The last 30 years

- Water attenuation (slowing down) by holding on site – below ground tanks, attenuation basins, ponds etc.
- Reversion to ‘green field run-off rates’.
- Measure of water cleansing by precipitation of solids.

Swales & Raingardens

The last 10 years

- Water attenuation.
- Vegetation cleansing.
- Soil medium filtration.

Rain Gardens & Bioswales

The advantages

- Lowest cost LID tree pit
- Landscaping feature
- Effective at removing urban pollutants
- Maintain ground porosity
- Adds additional attenuation capacity
- Flexible layout
- Easy retrofit capability

The disadvantages

- Requires landscaping and management
- High maintenance
- Susceptible to clogging if poorly managed
- Becomes unsightly when not upkept
- Unsuitable for steep slopes
- Mulch layer replacement
- Reduced usable ground space

One tree within a **880 ft^3**
GreenBlue Urban **RootSpace** system can
attenuate
>1,450 gallons of **stormwater**.

Utilizing trees for Sustainable stormwater management

GreenBlue® URBAN

Stormwater Canopy Interception volume

~ 1 Inch Rainfall Event

Xiao Q., and E.G. McPherson, 2003. Rainfall interception by Santa Monica's municipal urban forest. Urban Ecosystems.

2" Caliper Jacaranda versus
22" DBH London Plane Tree

Jacaranda Acutifolia
(~2" Caliper)

15.9%
Interception

Platanus x acerifolia
(~22" Caliper)

79.5%
Interception

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Utilizing trees for Sustainable stormwater management

Trees are an excellent resource for stormwater management

Sustainable and eco-friendly

Make sure trees are healthy, mature and strategically planted

HOW CAN WE BETTER UTILIZE TREES FOR LOW IMPACT DEVELOPMENT (LID)

Utilizing trees for Sustainable stormwater management

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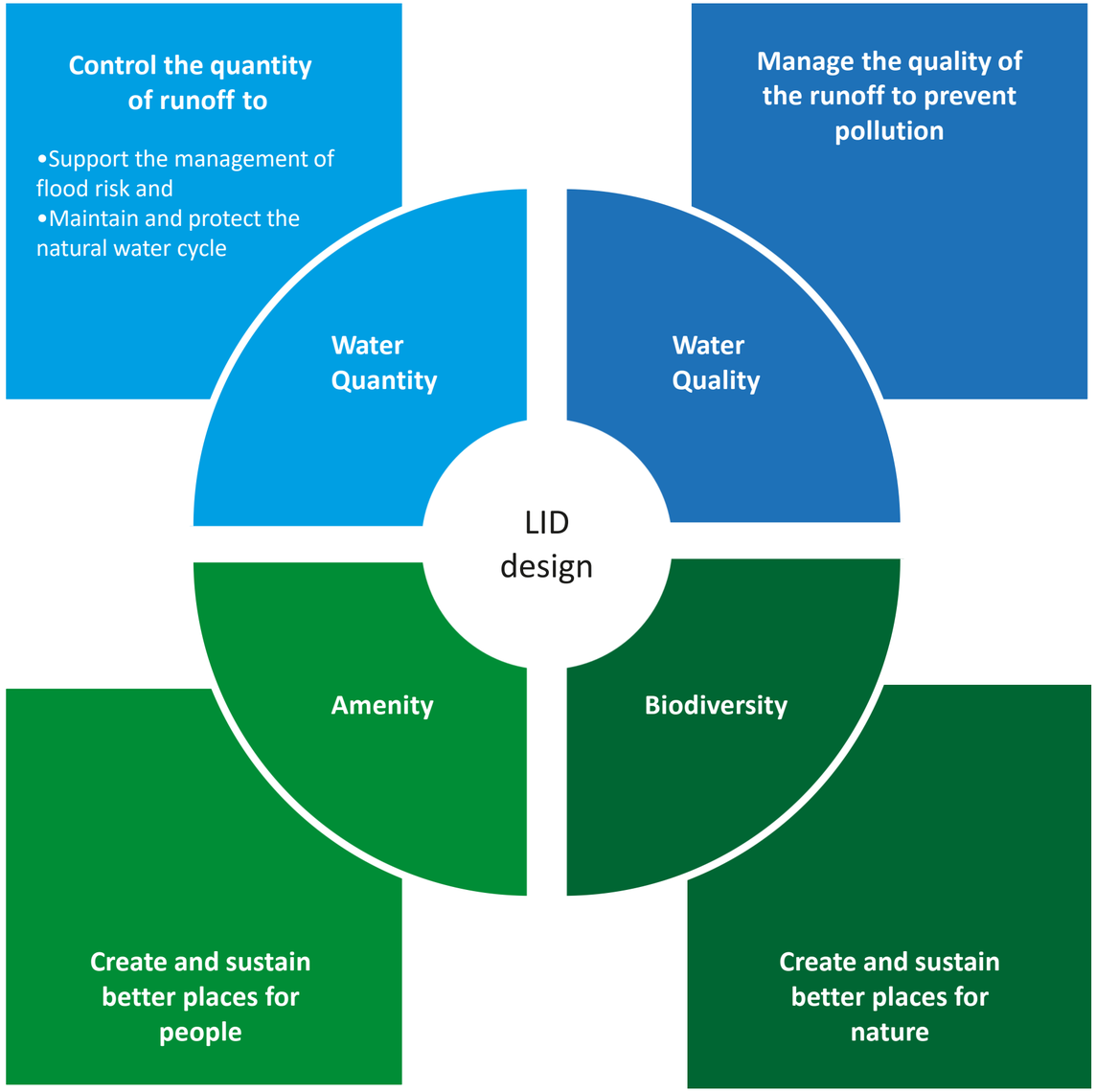
Why use a tree as part of a LID system?

- Canopy interception
- Water draw for transpiration
- Deep infiltration to surrounding soil
- Symbiotic relationship with soil mycorrhiza helps deal with pollutants
- Meets the requirements of the four pillars of LID strategy



01.

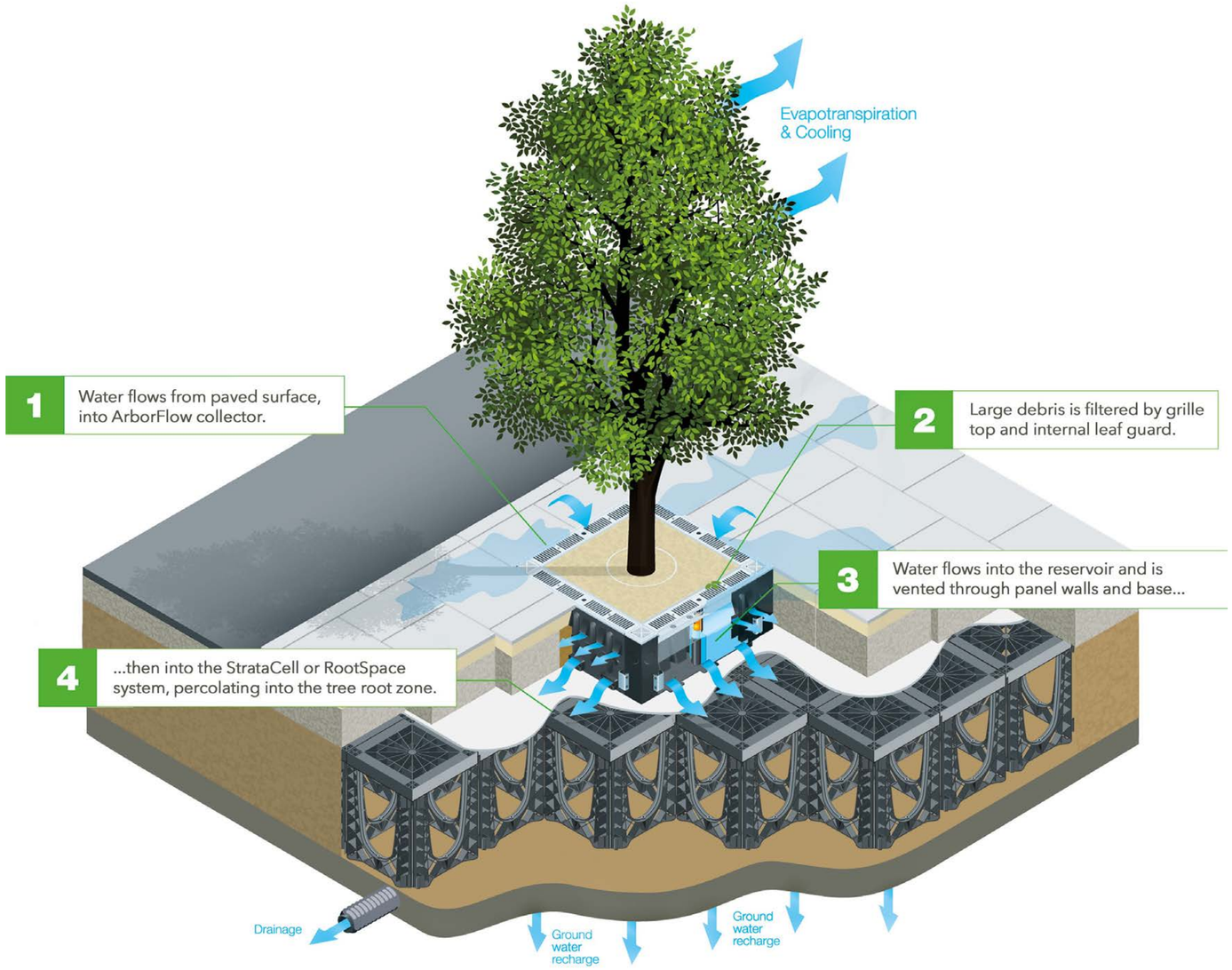
LID tree pit design

GreenBlue URBAN

How the ArborFlow System works

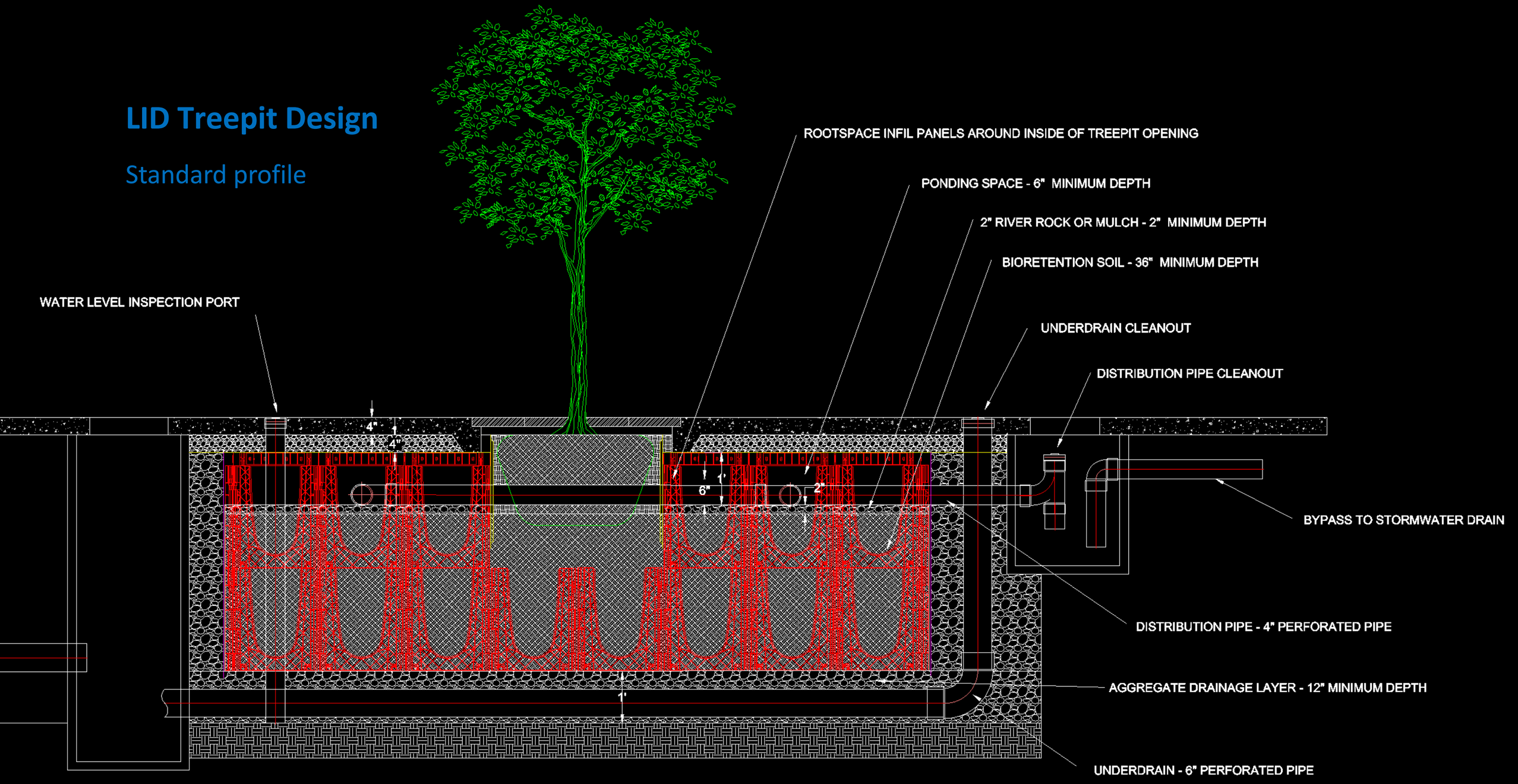
Managing surface water runoff

1. Water flows into the stormwater inlet
2. Debris is filtered
3. Water flows through and is vented
4. Enters system, percolating into roots



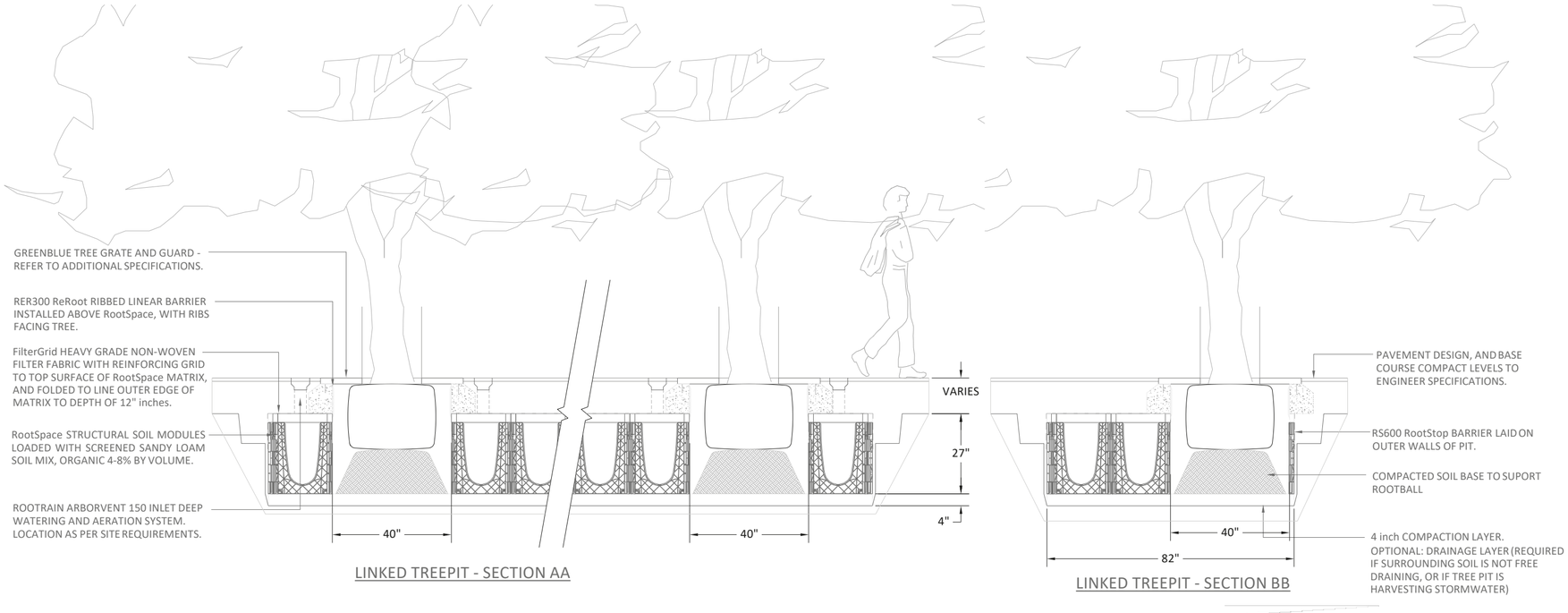
LID Treepit Design

Standard profile



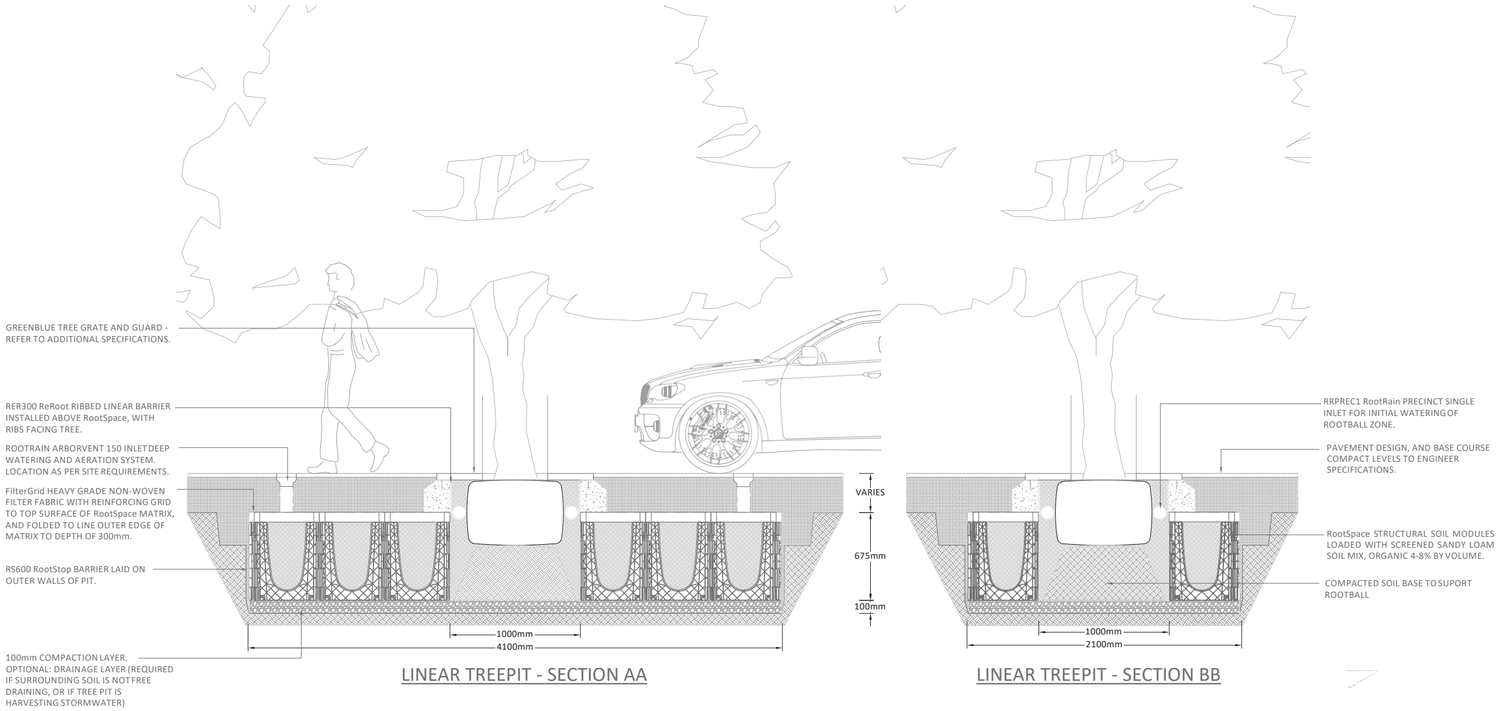
Streetscapes

Standard profile



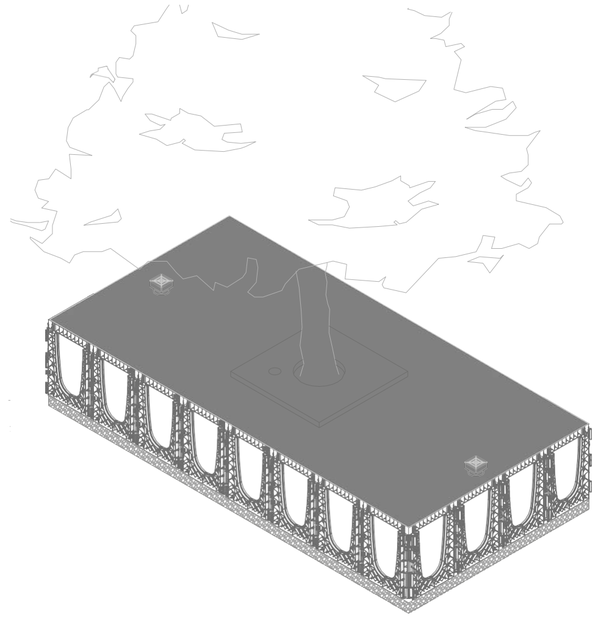
Parking lot

Standard profile



LINEAR TREEPIT - SECTION AA

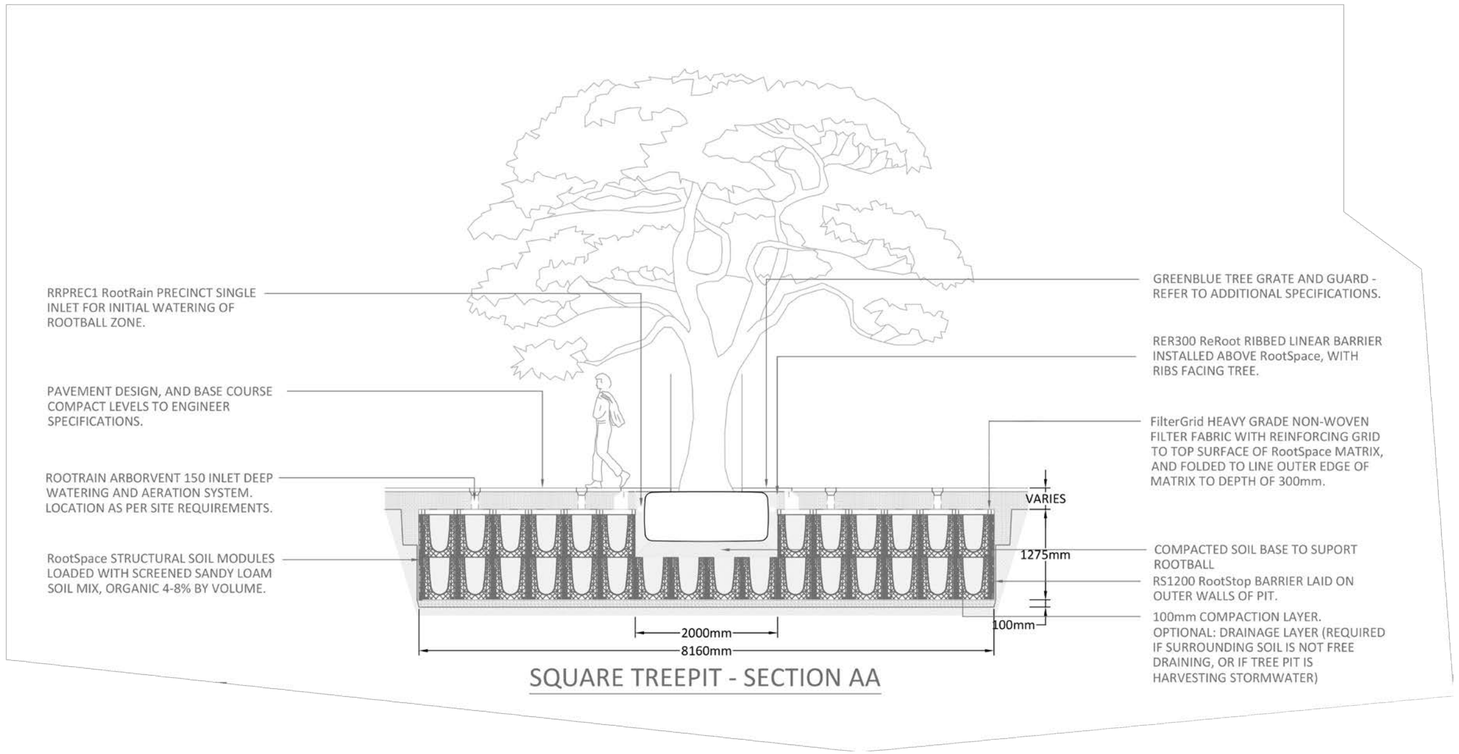
LINEAR TREEPIT - SECTION BB

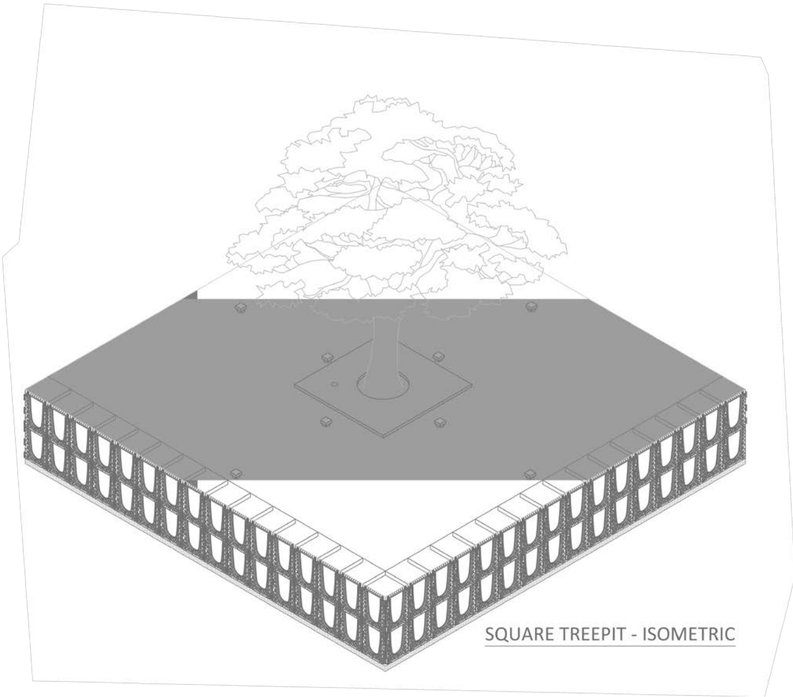


LINEAR TREEPIT - ISOMETRIC

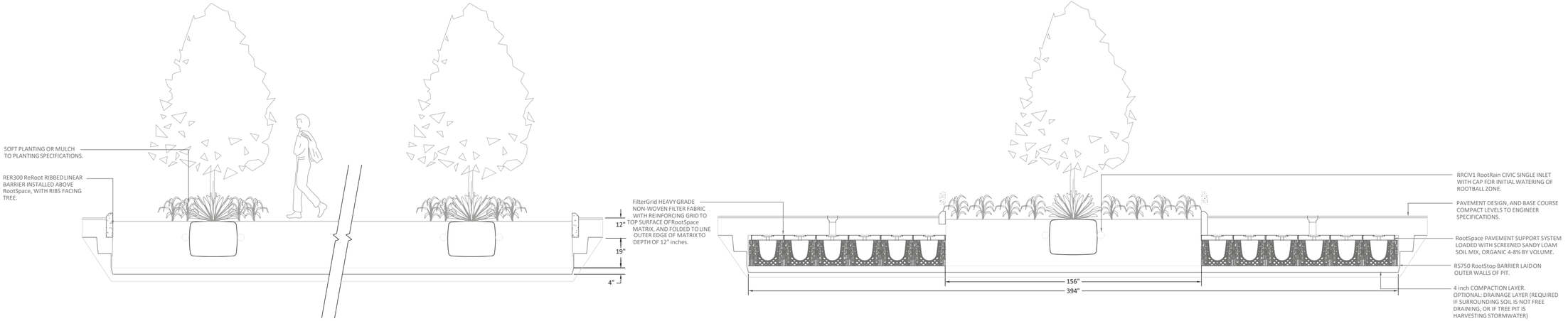
Pedestrian plaza

Standard profile





Combining Rain Gardens with LID tree planting



LINKED TREEPIT - SECTION AA

LINKED TREEPIT - SECTION BB

Requirements for a healthy tree

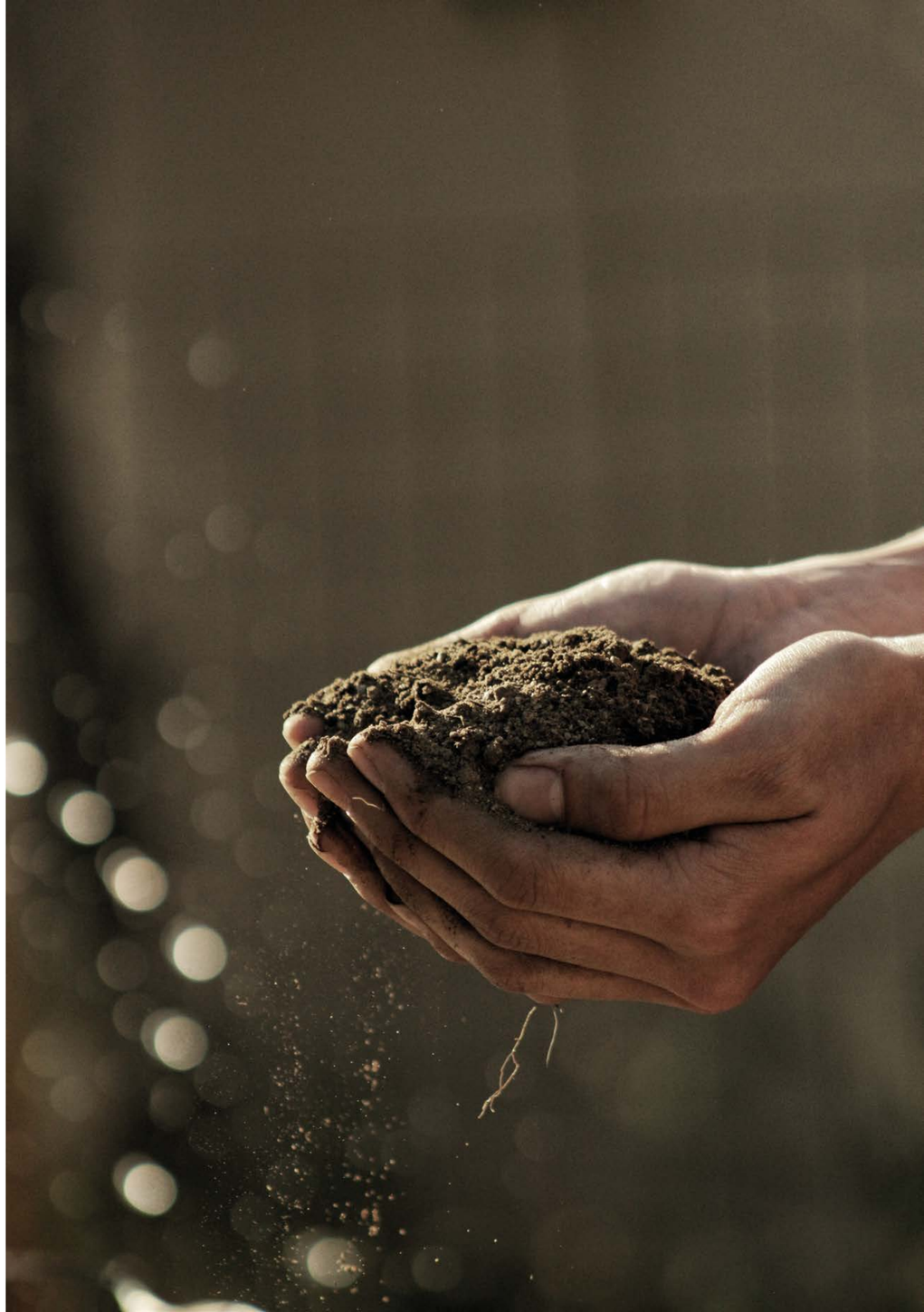
- Soil
- Water
- Air
- Protection
- Maintenance
- Support
- Correct tree species choice

Green Infrastructure Tree Species Selection Guide

DOWNLOAD IT HERE:
bit.ly/gi-species

Soil

- Constituent parts of soil
- Percolation rates
- Particle size analysis
- GreenBlue Urban rootzone soil mixes
- Need for uncompacted soil medium



The problem with compacted soil

- Eliminates macro pores (Lack of gaseous exchange, ion exchange, and microbiological activity)
- Detrimental to root growth
- Limits water movement
- Unable to endure intermittent inundations in a heavy storm
- Limits ability for tree to extract nutrients
- Removes space for attenuation and transport
- Uncompacted soil attracts air for long-term health

Historic uncompacted soil case study

Northumberland Avenue, London, UK

Trees now 150 years old and capable of dealing with in excess of >2,000 gallons of stormwater each.

Using the same concept of using an engineered construction to protect soil from over compaction.

The story of the soil cell

- List soil cells and dates launched etc.
- 100% recycled material
- Class leading load bearing capacity
- Recyclable up to five times
- Side infill panels for maximum lateral stability
- Fully interlocking design, creating one integral structure.

RootCell® (2001)

StrataCell® (2007)

RootSpace® (2016)

RootSpace®

Recreating forest floor
soil conditions

Utilizing trees for Sustainable stormwater management

GreenBlue Urban

The Principal Components

- **Load bearing soil cell or panel structure**
  - RootSpace®

The Principal Components

- Load bearing soil cell or panel structure
- **Root Management**
  - Root Barriers
  - Root Directors

The Principal Components

- Load bearing soil cell or panel structure
- Root Management
- **Control Chamber - Inlet & outlet control**

The Principal Components

- Load bearing soil cell or panel structure
- Root Management
- Control Chamber - Inlet & outlet control
- **Drainage**
  - Positive drainage
  - Infiltration into the soil

The Principal Components

- Load bearing soil cell or panel structure
- Root Management
- Control Chamber - Inlet & outlet control
- Drainage
- **ArborFlow**
  - Curb Inlet

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  - Traditional gutter

The Principal Components

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  - Curb Inlet
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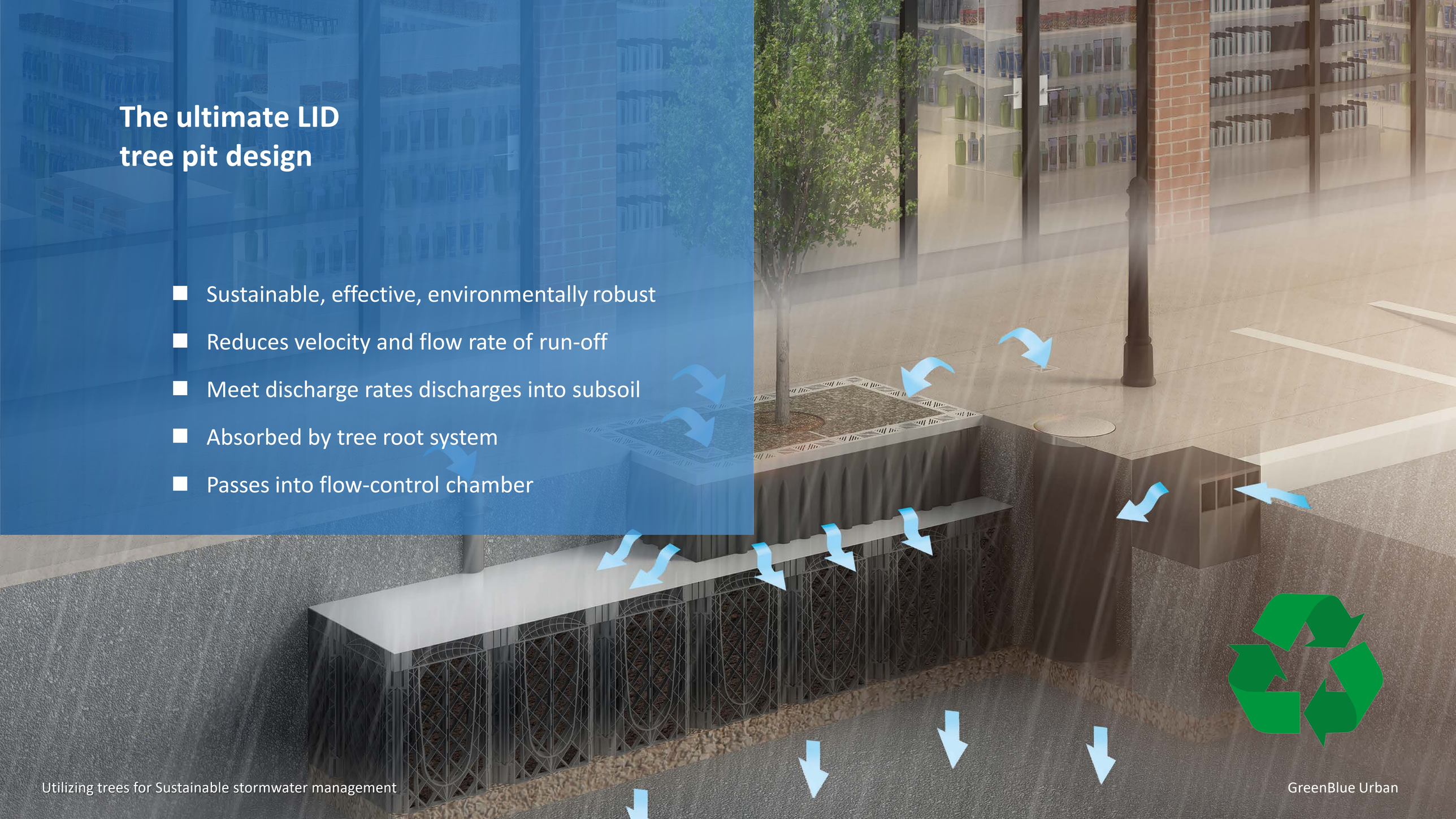
  - Traditional gutter
  - Weir Inlet

The Principal Components

- Load bearing soil cell or panel structure
- Root Management
- Control Chamber - Inlet & outlet control
- Drainage
- **ArborFlow**
  - Curb Inlet
  - Permeable Paving
  - Traditional gutter
  - Weir Inlet
  - Linear drain

The ultimate LID tree pit design

- Sustainable, effective, environmentally robust
- Reduces velocity and flow rate of run-off
- Meet discharge rates discharges into subsoil
- Absorbed by tree root system
- Passes into flow-control chamber



02.

Maintenance

Maintaining LID tree pits

Drainage requirements

Spring
Check and clear stormwater inlets.

Summer
Inspect and clear debris from inlets.

Late Fall
Clear leaf debris from inlets.

Maintaining LID tree pits

Tree requirements

Summer
Irrigate regularly until establishment.
Check canopy for pest and disease.

Early Winter
Inspect canopy and branch structure for defects etc.

Early Spring
Inspect tree ties.
Clear leaf debris from inlet channels. Top up mulch levels.

Late Fall
Clear fallen leaves.
Prune as required.

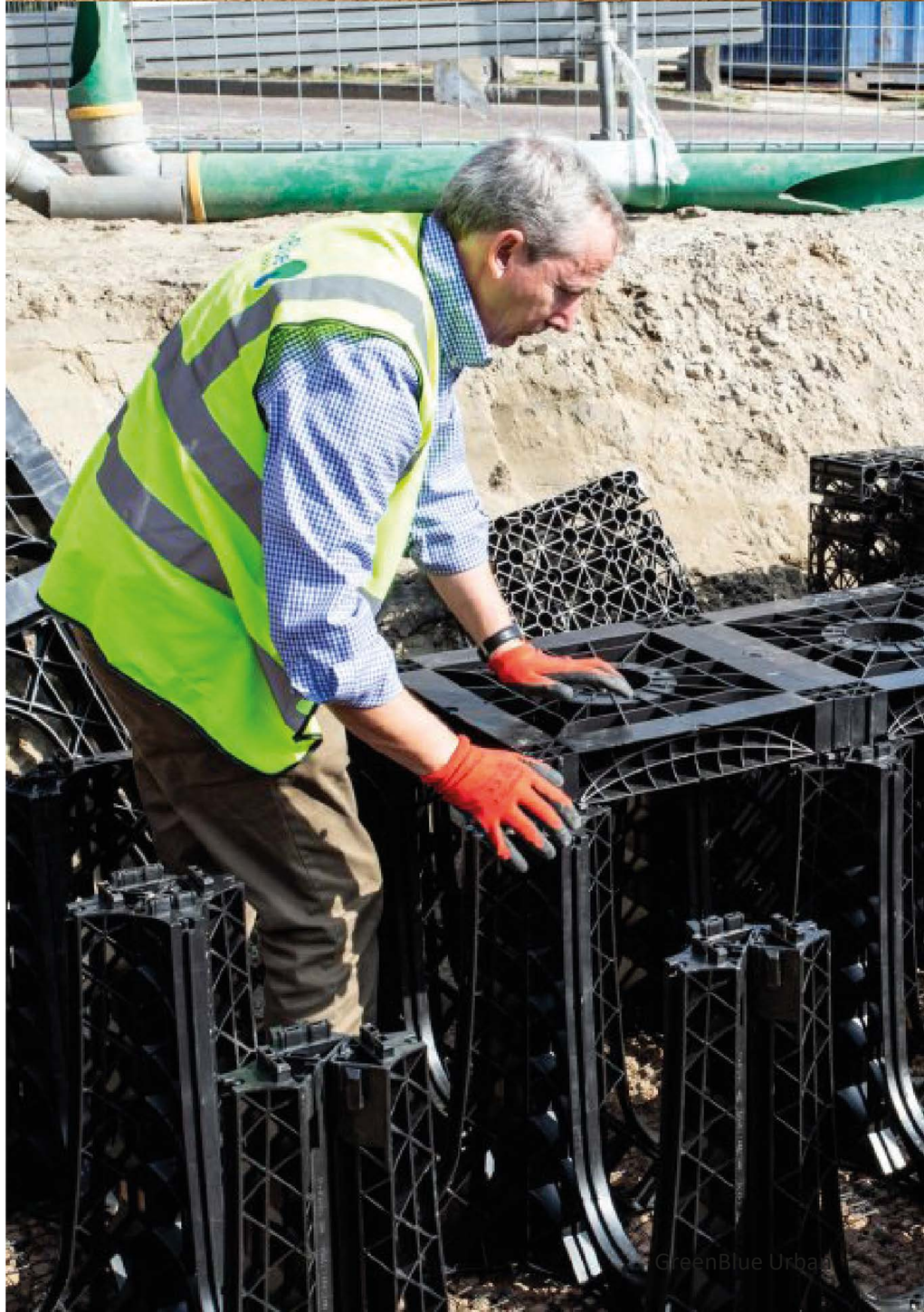
03.

Water Resilient Cities

Utilizing trees for Sustainable stormwater management

Water Resilient Cities

- Improve adaptation to heavy rainfall
- Innovative and creative LID in retrofit
- Increase awareness of retrofit issues
- Mitigate climate change
- Network of private and public sector partners
- Shared knowledge



Cities Making a Difference in
Sustainable Stormwater Management

City of Toronto, Ontario

Stormwater Quality

80% removal of Total Suspended Solids
from site runoff

E. coli removal of <1000 / 100 ml (during wet periods of Jun - Sep) and <100 / 100 ml (during dry periods of Oct - May)

Cities Making a Difference in
Sustainable Stormwater Management

City of Toronto, Ontario

Urban Forest

Enhance the extent and longevity of the urban forest
Increase tree canopy to 40% by 2022

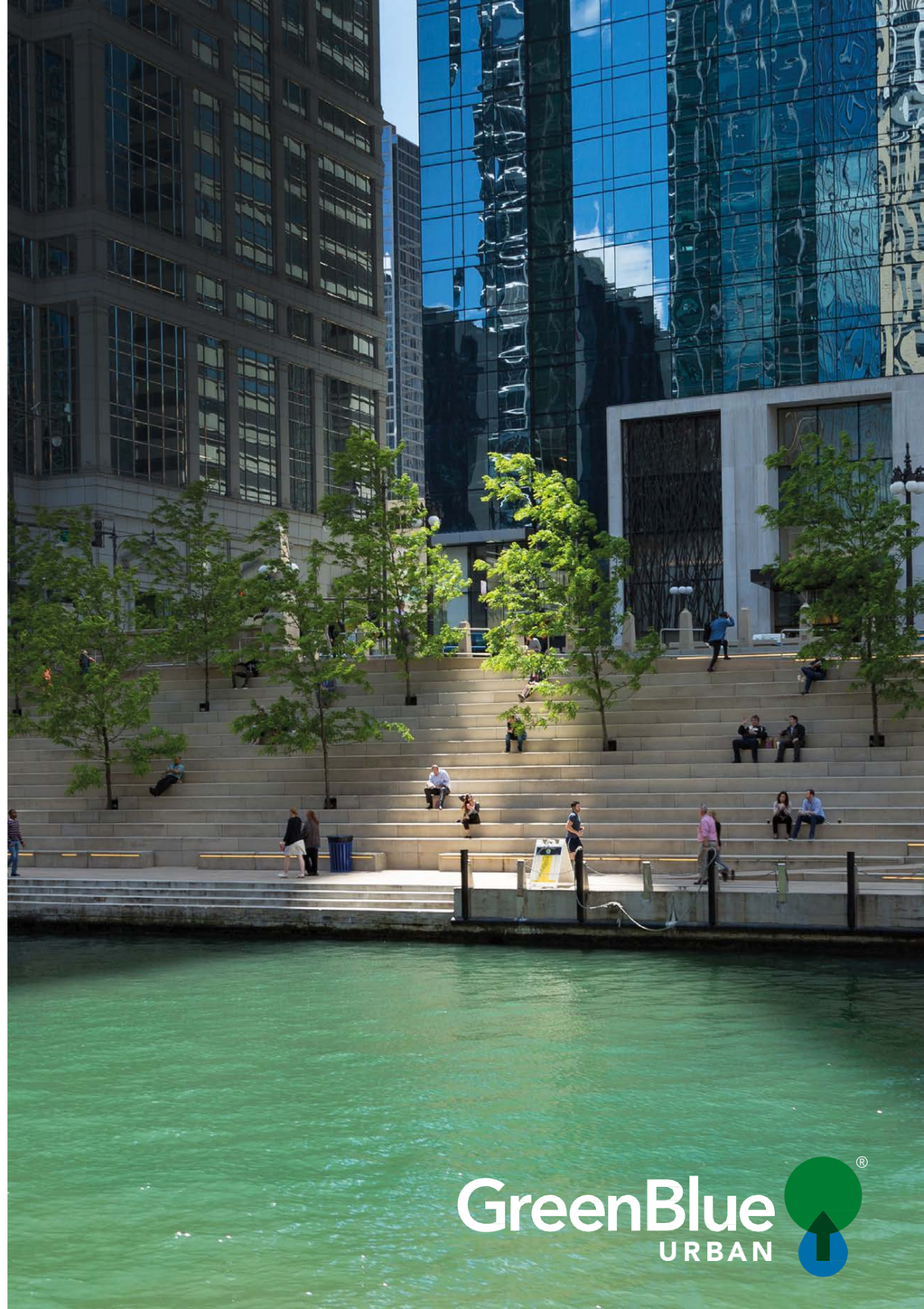
Mitigate urban heat island effect

Enhancing air quality

04.

Case Studies

Successful LID
systems implemented.



Case study:
Gregory Road - West Palm Beach, FL

A residential project on with RootSpace was specified by the civil engineer as stormwater storage as a more cost- effective alternative to gravel drywell due to:

- Reduced excavation requirements
- Reduced waste removal
- Reduced infrastructure damage

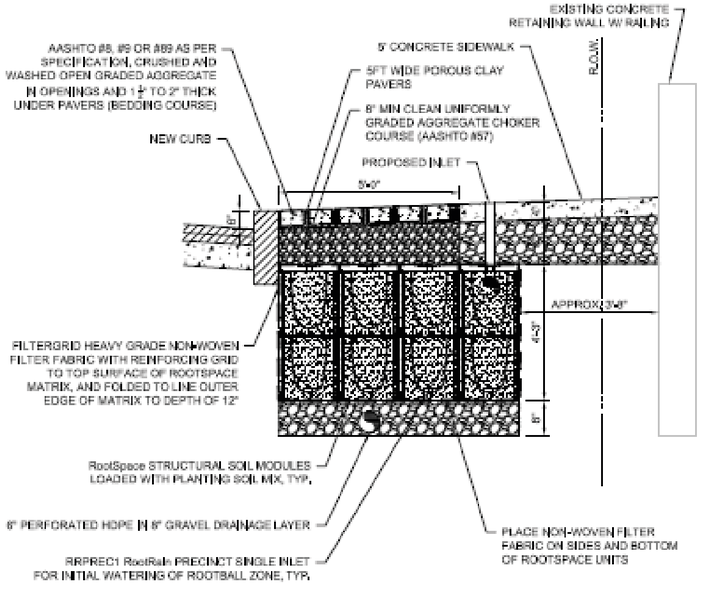
Case study:
Jack Layton Ferry Terminal
Toronto, ON

RootSpace was used to provide uncompacted soil volume for 19 trees. A linear drain channeled surface water runoff into the RootSpace system.

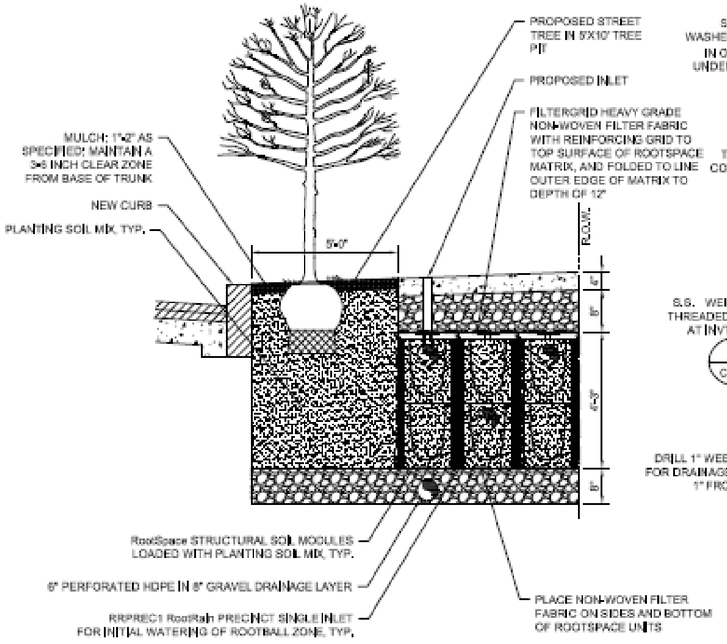
Case study:

Jack Layton Ferry Terminal
Toronto, ON

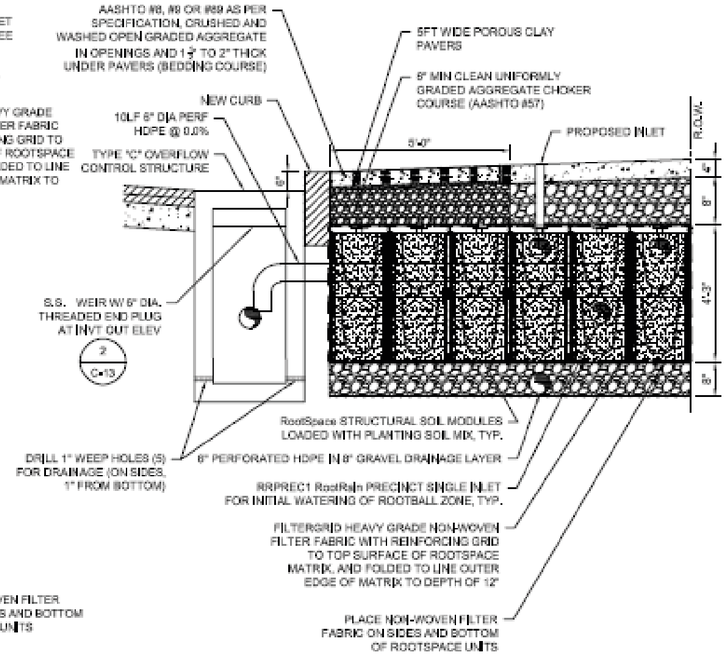
Case study:
City of Lancaster, Pennsylvania



1 INFILTRATION TRENCH #4 AT RETAINING WALL
N.T.S.
C-4 & L-1



2 INFILTRATION TRENCH #4 WITH TREE
N.T.S.
C-4 & L-1



3 INFILTRATION TRENCH #4
N.T.S.
C-4 & L-1

Cities Making a Difference in
Sustainable Stormwater Management

City of Lancaster, Pennsylvania

$2.8 million in air quality, energy, and climate related benefits annually

Reduced gray infrastructure capital costs of $120 million

Reduced wastewater pumping and treatment costs of $661,000

Reduced stormwater volumes

Improved stormwater quality

Enhanced aesthetics Reduced air pollution Improved public health Increased property values

Reduced energy costs associated with cooling and heating buildings

Reduced heat island affect

05.

About GreenBlue Urban

About GreenBlue Urban

History

Founded in 1992 to research and provide urban tree planting solutions.

Provide guidance to local authorities, landscape architects, engineers.

Market leader in specialist tree pit products.

Unrivalled support service in the urban tree-planting world.

About GreenBlue Urban

Consulting

Landscape architecture and design

Stormwater management & services

Support & training

06.

Conclusion

“

The challenge for the urban designer is that for trees to succeed and achieve their potential, they require access to **large volumes** of uncompacted soil. With space in cities being at a premium, and below ground congested with services and utilities, *specialized products* are required to overcome these challenges.

”

The principal considerations

Best Management Practices for
LID stormwater management

Load bearing Pavement Support System

Irrigation & Aeration for healthy soil

Drainage & Overflow provision

Adequate uncompacted soil volume

Root management to protect infrastructure

Source control maintainable inlets

The 10 focus points

1. Review catchment areas,
2. Ascertain whether ground recharge is acceptable,
3. Decide number of trees and species,
4. Design tree pits to accommodate soil for each tree,
5. Ensure appropriate uncompacted soil volume,
6. Link tree pits together,
7. Choose suitable water inlets,
8. Consider weir and rain inlets,
9. Decide where tree pits will drain to,
10. Run completed designs past support team.

Thank you for listening

Trees and Water Sensitive Urban Design

A step by step guide to successfully planting trees in a LID system.

GreenBlue URBAN