



low impact development technical workshop series

urban trees

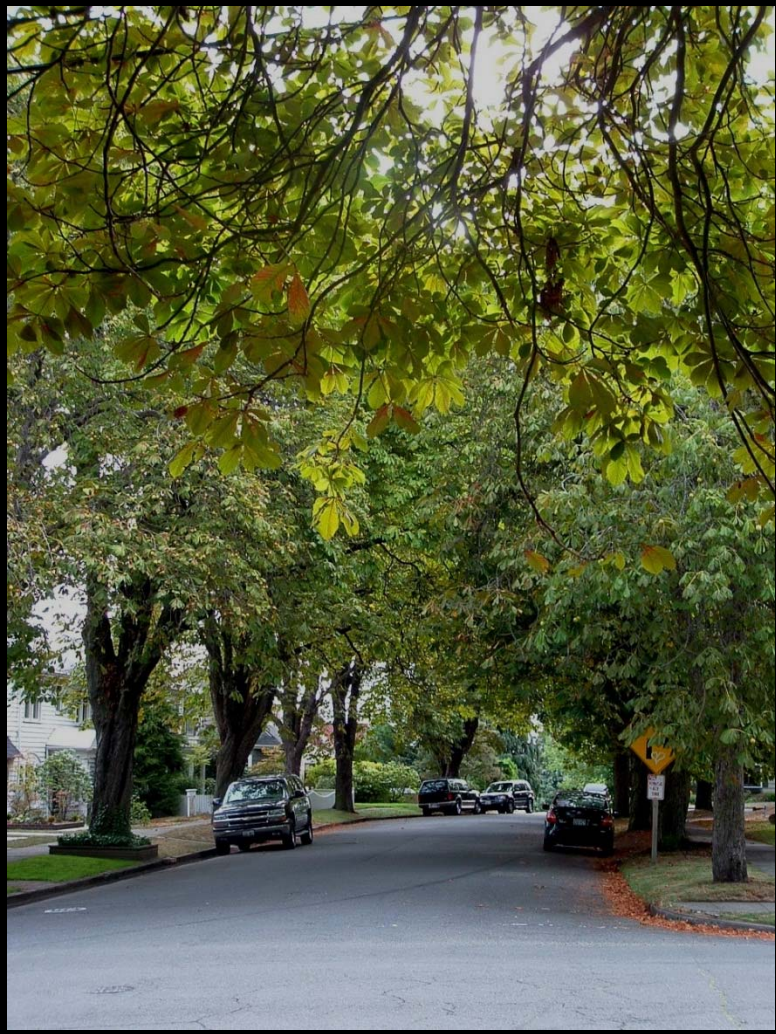
Topics

Integrating stormwater management and healthy trees

Above and below ground growing space

Stormwater flow control and trees

Integrating stormwater management and trees

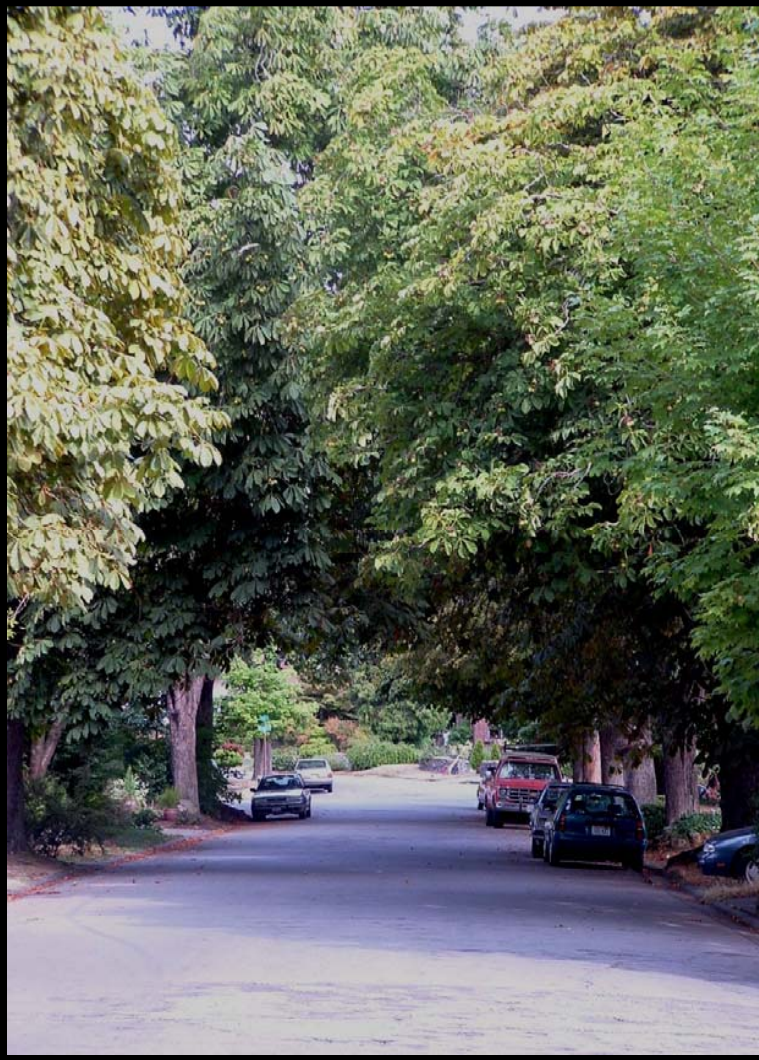


Multiple benefits

- Energy conservation.
- Air quality.
- Carbon sequestration.
- Aesthetics and increased property value.
- Stormwater flow reduction.

trees and stormwater management

Integrating stormwater management and trees

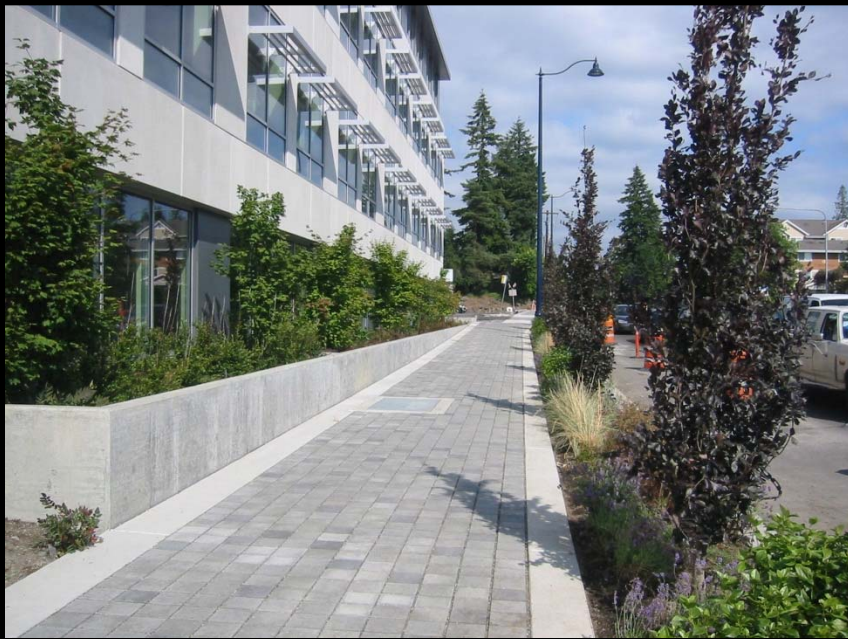


Stormwater context

- Larger mature trees provide more benefit than smaller trees.
- Evergreen better than deciduous.
- Adequate soil volume and quality critical.
- Proper drainage design critical...too much water can kill trees faster than too little.

trees and stormwater management

Integrating stormwater management and trees

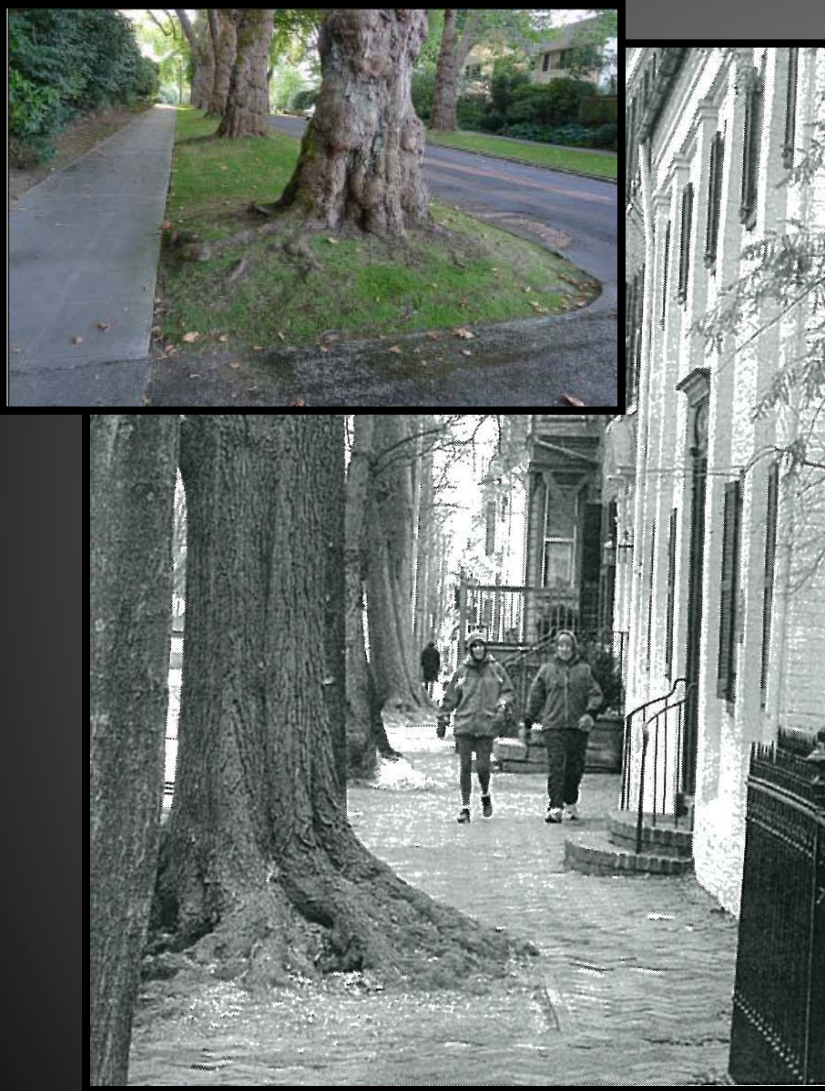


Site assessment

- Available above and below ground growing space.
- Soil type and available water.
- Vehicle and pedestrian sight lines.
- Proximate utilities and structures.
- Sun exposure and prevailing wind.
- Maintenance.

trees and stormwater management

Integrating stormwater management and trees



Key decisions

- Plant in the best/appropriate places with highest quality soils and adequate soil volume.
- Design for larger growing spaces.
- Do not restrict trunk flare of mature tree...plan ahead
- Use permeable surfaces for hard surfaces surrounding tree.
- Protect the tree from surrounding activities.
- Drainage.

trees and stormwater management

Integrating stormwater management and trees



Drainage

- If not directing flow to tree area and seasonally high GW below tree pit subgrade then likely no under-drain needed.
- If directing flow to tree area careful consideration of soils, tree species and under-drain.
- Generally planting pit above rooting zone (18-24 in.) should drain down within 48hrs.
- If under-drains used, incorporate an accessible control structure if possible.
- SilvaCell has GULD for WA.

Integrating stormwater management and trees

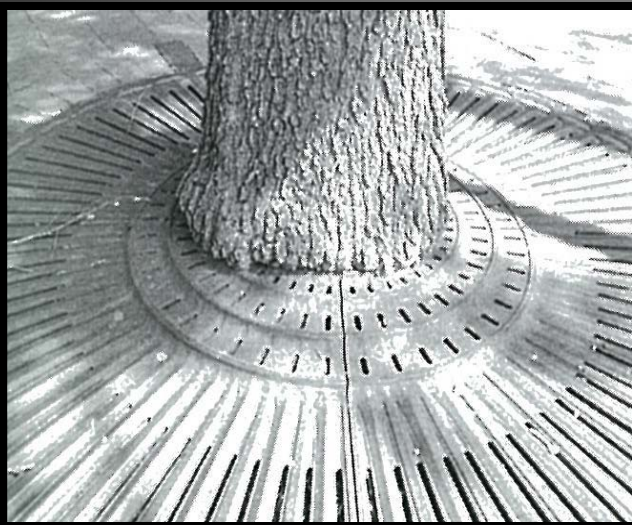


Reducing compaction (construction)

- Clearly mark protection and staging areas on plans and in the field.
- Review plans and coordinate throughout construction with foreman and crew.
- Robust fencing and clear signage declaring protection objectives and penalties.
- If access unavoidable.
 - Foot access: 6" layer of arborist wood chips.
 - Vehicle: 1" steel plate or 4" thick timber with 2-3" AWC or ¾" ply with 6-8" AWC.

trees and stormwater management

Integrating stormwater management and trees



Reducing compaction (long-term)

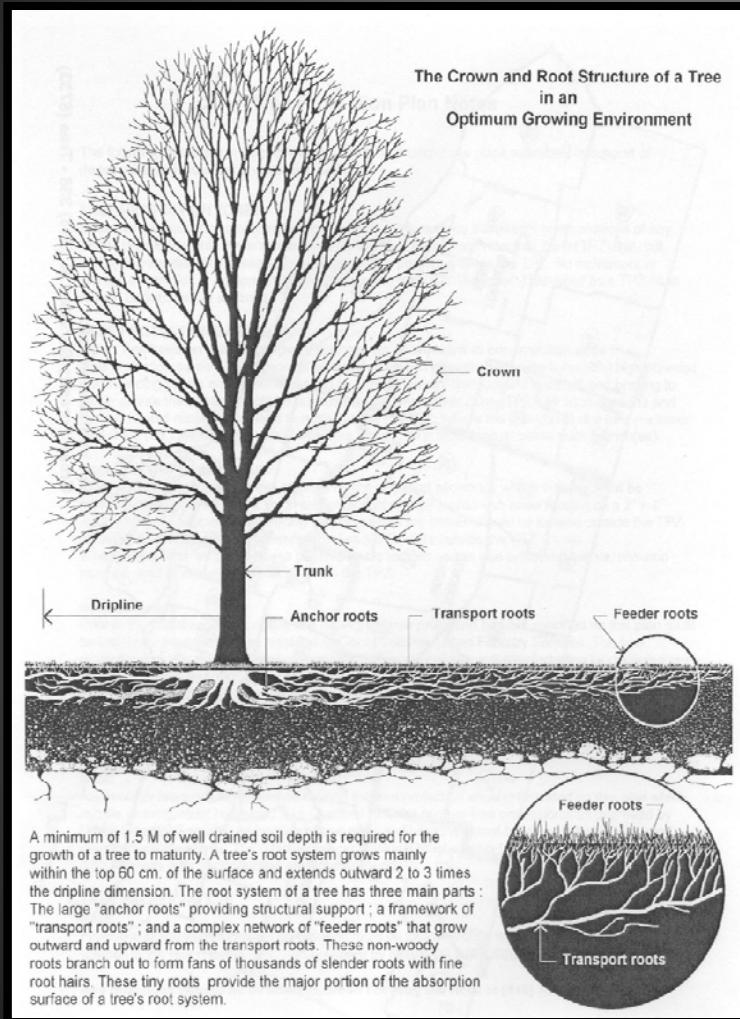
1. New trees

- Mulch tree planting bed with 2-4" of AWC. Keep chips 1' back from trunk. Replenish 1-3 yrs.
- Barriers.
 - Wheel stops.
 - Low fences.
 - Curbs.
- Tree grates...poor option.

2. Existing trees

- Mechanical.
- Soil amendments (compost and other biological).

Integrating stormwater management and trees



Soil depth

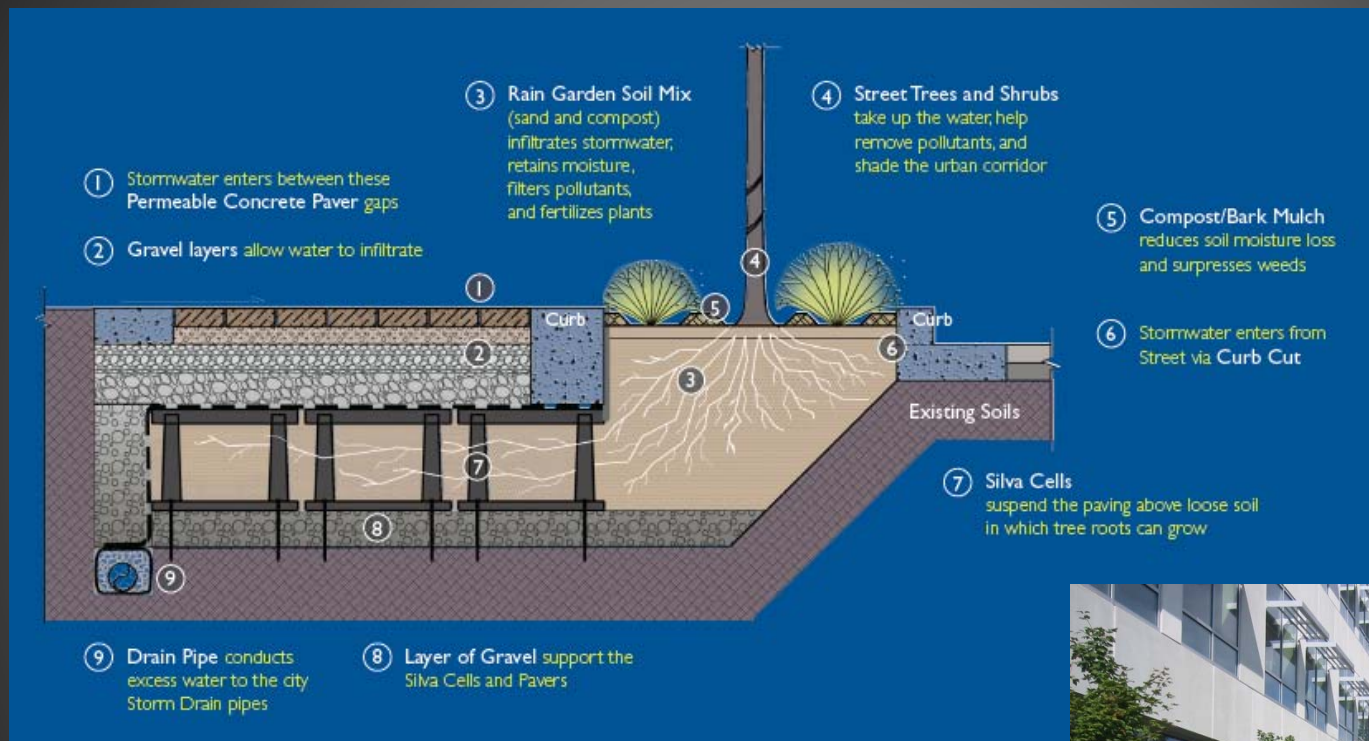
- 30-48" extended for a 10' radius around tree in lawn areas.

Soil volume

- Recommendations vary.
 - Urban: 0.38 m³ soil per 1 m² canopy projection for loam, no irrigation with 30" annual rainfall.
 - Lindsey and Bussuk: 0.24 m³ per 1 m² canopy projection.
- Structural Soils require volume for structural component => less available soil. CU Structural Soil™ has ~ 20% available soil.

Integrating stormwater management and trees

Soil and rooting volume strategies

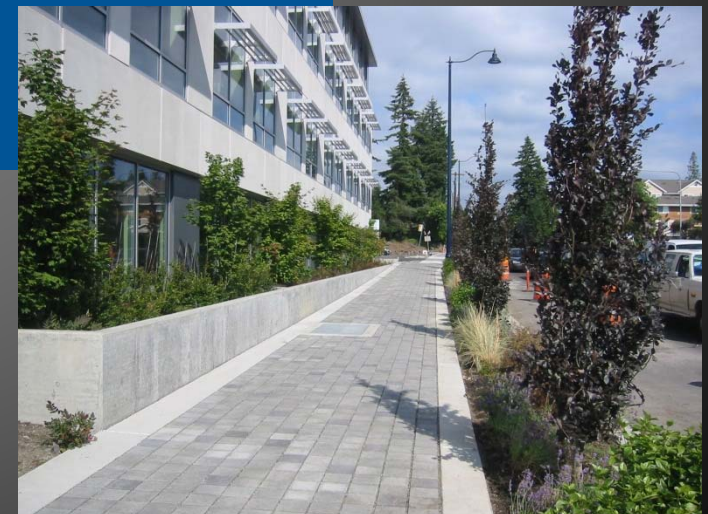


SINGLE CELL WITH DECK



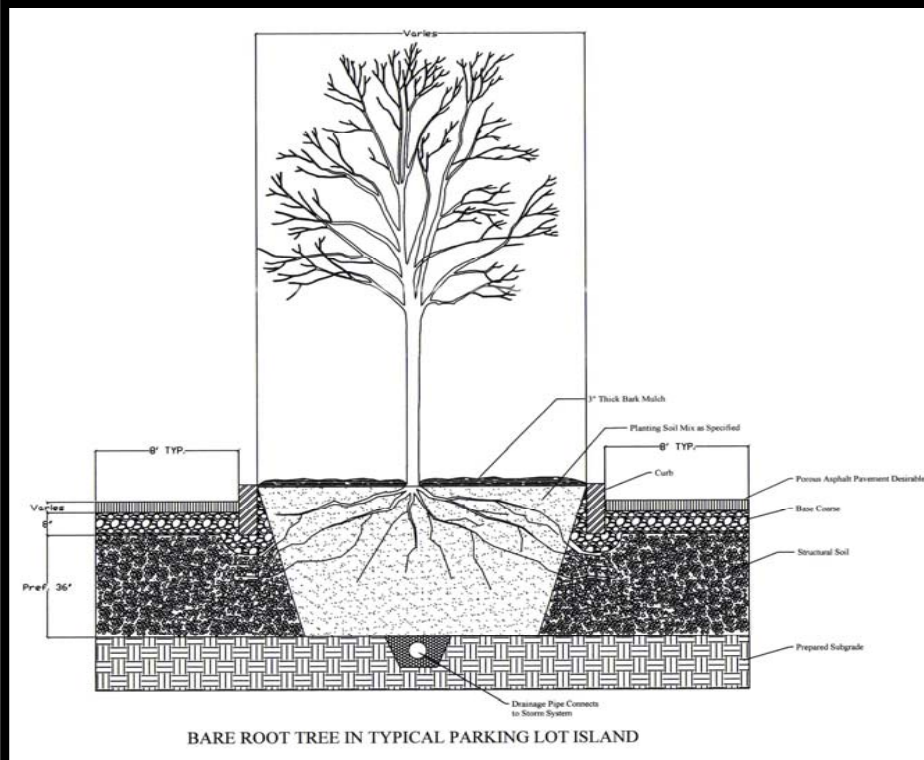
1. Rigid cell systems

- Modular frames.
- Support high loads.
- Most volume available soil for trees



Integrating stormwater management and trees

Soil and rooting volume strategies

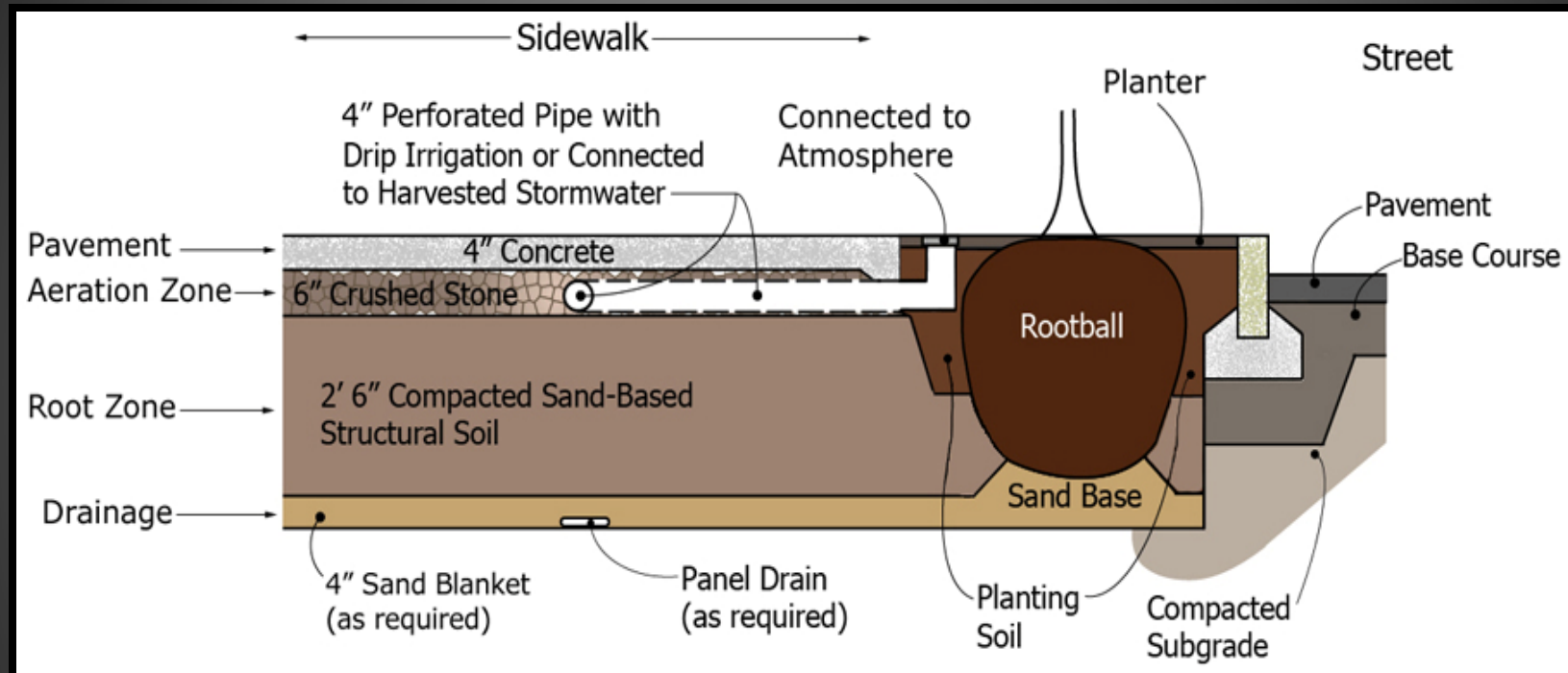


2. Structural soil

- Crushed aggregate (typ. 0.75-1.5" fine grained soil and polymer.
- Good porosity (25-30%) and permeability(>20in/hr), load bearing. Lower soil availability (~20%).

Integrating stormwater management and trees

Soil and rooting volume strategies

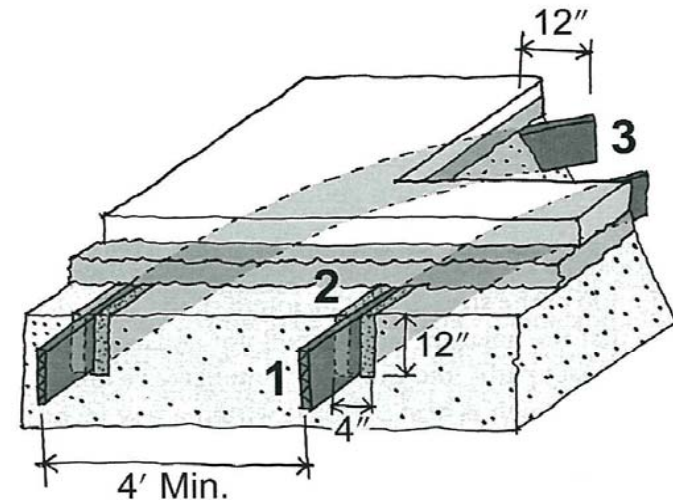
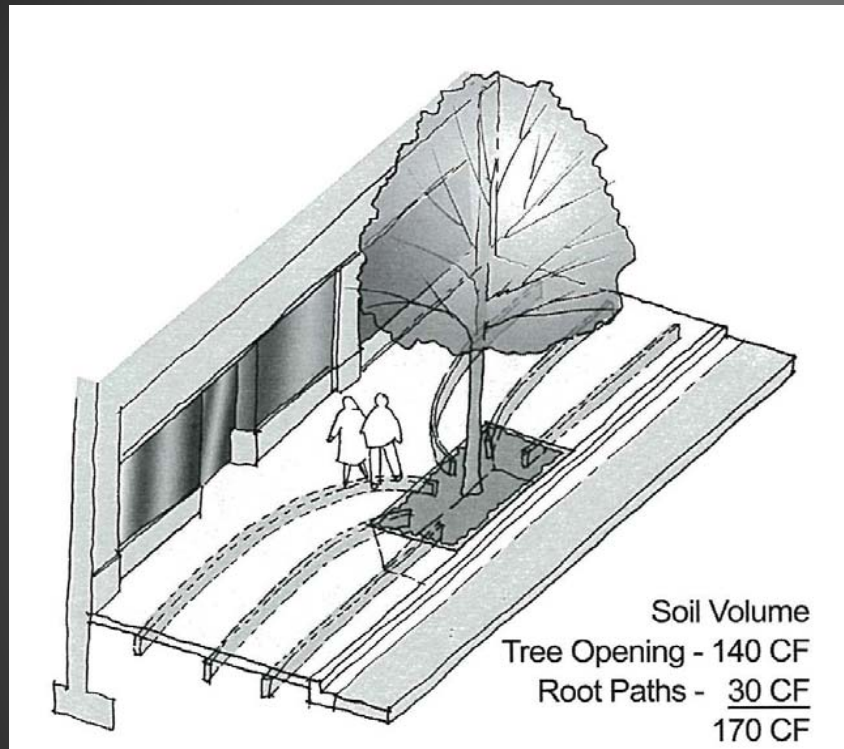


3. Sand based structural soil

- Medium to coarse uniformly graded sand with compost (2-3% by volume) and 2-4in/hr Ksat typical.
- Typically 30" deep
- Non-proprietary.

Integrating stormwater management and trees

Soil and rooting volume strategies



4. Root paths

- Guide roots out of confined planting areas.
- Do not add much soil volume, but interconnect planting areas.

Integrating stormwater management and trees

Soil and rooting volume strategies

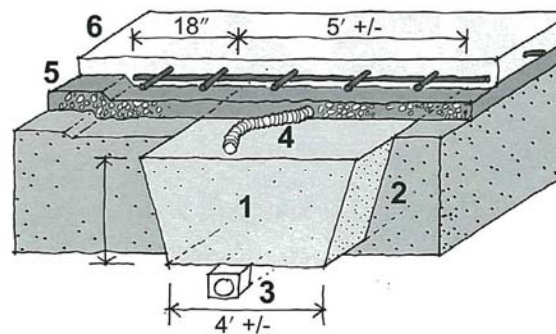
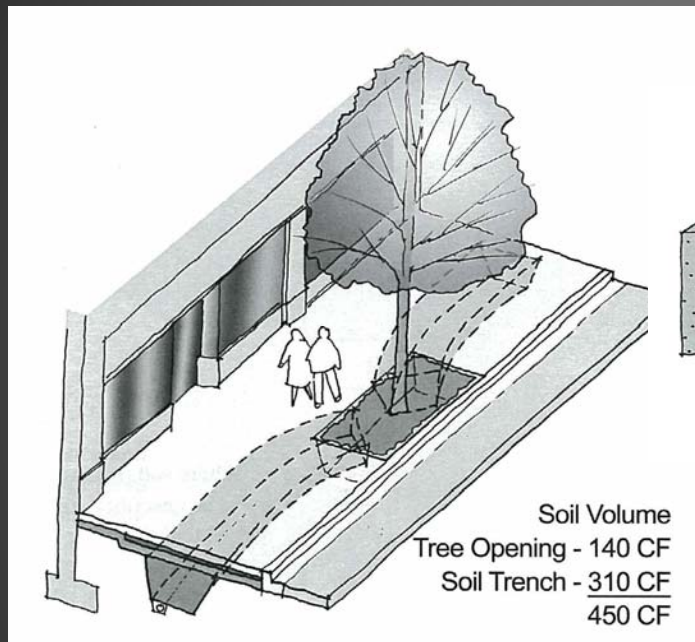


Figure 2.6.13. Soil trench detail.

1. Loam topsoil compacted to 80 percent.
2. Slope sides of trench. Assure soil beyond trench is compacted to 95 percent.
3. Drain line.
4. Perforated water line in gravel layer.
5. Gravel base course (#57 stone).
6. Concrete paving. Thicken the concrete over the trench and for a minimum of 18 inches past the edge of the trench. Concrete reinforcing per project engineer.

4. Root trenches

- Increase soil and rooting volume.
- Typically 5" wide filled with topsoil or designed mix.
- Reinforce sidewalk to span trench.

Performance



Interception and evaporation

- Xaio (2000)...Mediterranean climate
 - Deciduous: 15% annual precip intercepted and evaporated.
 - Evergreen: 27% annual precip intercepted and evaporated.
- Asadian (2009)...Vancouver, BC
 - Seven events, 377mm total precip, evergreens.
 - Interception and evaporation ranged from 17-89%.
 - Note that 89% is high...authors speculate high rate due to increased temps in urban area.

trees and stormwater management

Performance



Infiltration

- Bartens (2008)
 - Black oak (course root structure) and red maple (finer root structure).
 - Both penetrated soils in containers with bulk densities of 1.3 and 1.6 g/cm³.
 - Infiltration rates were 63% higher in lower compaction soil and 153% higher in higher compaction soil compared to control with no plants.