MAPLEWOOD MALL TREE TRENCHES – DESIGN AND IMPACT ON STORMWATER

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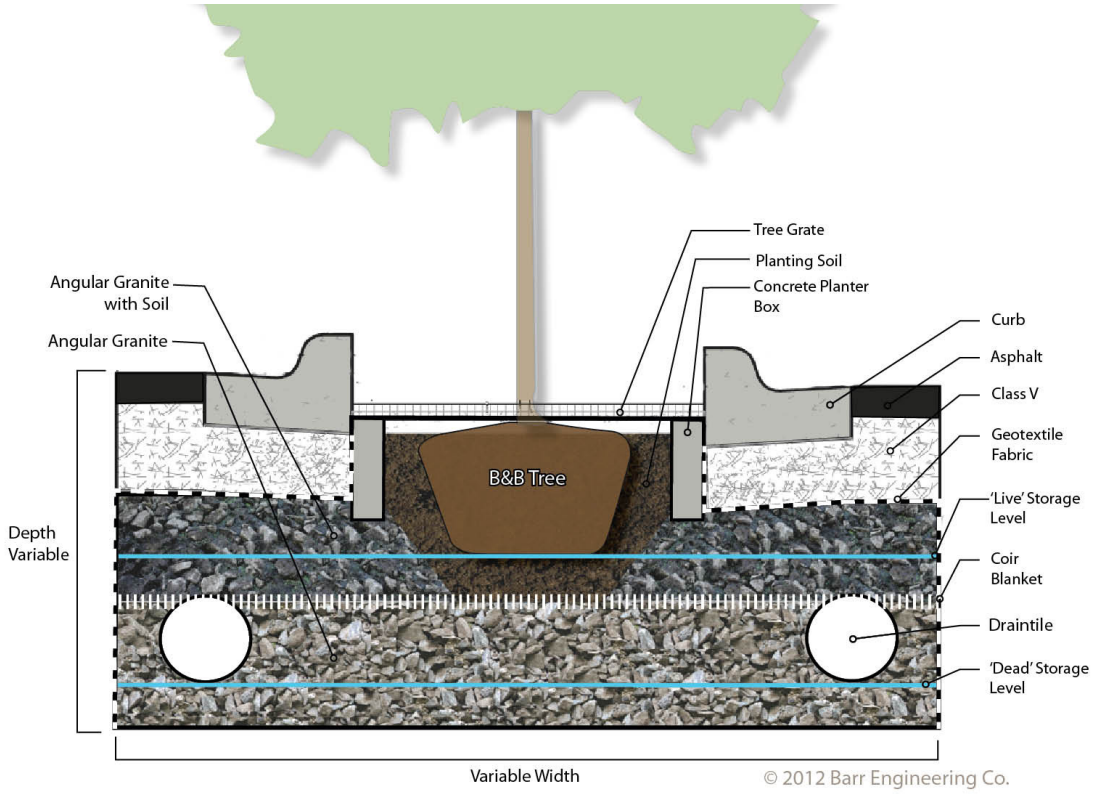
The Maplewood Mall tree trenches, implemented by the Ramsey-Washington Metro Watershed District, utilize a design adapted from tree specialists in Stockholm, Sweden that provides non-compacted soil for trees planted in highly impervious environments. This tree trench design differs from other designs due to both its heavy use of angular, load-bearing rock (angular granite), and the fact that a specified soil mix is washed into the rock after it has been compacted. In this way, the rock can support heavy traffic, but the soil in the void spaces between the rocks is non-compacted.

The cross section below illustrates the design of the tree trenches at Maplewood Mall. Stormwater from the parking lot is directed to sump catchbasins that are connected to draintile (perforated pipe) laid along a layer of angular granite that is "clear" (without soil in the void spaces). The draintile is flat (0% slope), allowing water to fill the trench equally. As stormwater rises to the layer of angular granite that is filled with soil, water is wicked up through the soil, watering tree roots from below. After a storm event subsides, water slowly drains out of the trench and away through the greater stormsewer system for the area.

The dead and live storage levels in the trench are set by an orifice and a weir in an Agri Drain structure that is downstream of each trench. The orifice and the weir levels are adjustable, in case the dead and live storage levels need to be changed in the future. As shown in the cross section below, the separation of the granite layer filled with soil and the clear granite layer is established with a layer of coir blanket. For the final phase of the Maplewood Mall project (Phase 4), the coir blanket layer is substituted with differently –sized angular granite layers that form a rock filter.

Below the weir in the Agri Drain structure, and assuming that no flow is leaving the orifice, the tree trenches were designed to hold 0.5 inches of stormwater running off from the tributary parking lot areas. However, taking into account that water will also leave the trenches during a storm event, the depth of runoff that can fill the trenches to brimming at the tree grates is much higher- 2.3 inches, falling at the rate of a 2-yr, 24-hr event in Ramsey County.



The Maplewood Mall project is a large scale project that is expected to have a large impact on the quality of the stormwater leaving the site. The table below highlights some of the project elements and their quantities.

Maplewood Mall Stormwater Features	**Quantity/Type**
Total Summed Length of Tree Trenches	~ 1 mile
Rain Gardens	14
Total Number of Trees in Trenches and Rain Gardens	325
Tree species (T = in tree trenches, RG = in rain gardens, SF = in enhanced sand filter)	Discovery Elm (T, RG), Accolade Elm (RG), Skyline Honey Locust (T, RG), Espresso Kentucky Coffeetree (T, RG) Common Hackberry (T,RG), Swamp White Oak (T,RG), Red Splendor Crabapple (RG), Spring Snow Crabapple (SF)
Sump catchbasins	117
Area of parking lot intercepted by tree trenches or rain gardens	~32 acres (90% of the entire Mall parking lot)

The Ramsey-Washington Metro Watershed District implemented this project at the Mall because it expects this system of tree trenches to both reduce stormwater volume and remove sediment and phosphorus from stormwater in the following ways:

Sump catchbasins and extended detention: The most basic way that the tree trenches will remove pollutants is through extended detention and inlet sumps. There are 117 inlet sumps throughout the tree trench and rain garden system that intercept the water coming off of the parking lot, catching the heaviest sediments before water enters the tree trench itself. Each trench also has extended detention storage upstream of a 1-inch orifice that holds water back for up to 48 hours (depending on the trench, and the storm event).

Infiltration effect: Most of the existing soils at Maplewood Mall are highly compacted silty clay. However, in some areas, localized lenses of sand have been uncovered during excavation activities. Some infiltration of stormwater may occur in these areas after right after construction, in other areas, infiltration may occur later, as tree roots penetrate the subgrade. In other areas, there may be little to no infiltration.

Interception: 325 trees will be planted in the parking lot by the time Phase 4 of the project is complete. The canopies of 325 trees at maturity, assuming each is approximately 30 feet in diameter, cover an area of 5.3 acres. Various researchers document that tree canopies can intercept large amounts of rainfall over the course of a year. According to www.treebenefits.com (a product of the National Center for Tree Research, US Forest Service), an American Elm with a 12-inch trunk can intercept 912 gallons of water in a single year.

Wicking of water into soil in the tree trenches: As the trenches fill with stormwater during a storm event, the water is held back in the trenches upstream of the weir and orifice that eventually drain them, rising up to the soil media that is washed into the rock. Water will wick up into the soil media, saturating it, making water available to tree roots. In this way, the soil will act as a sponge suspended in the upper half of the tree trench cross section, soaking up (thereby reducing) some of the stormwater that enters the trenches.

Uptake of water from tree roots: In addition to facilitating infiltration through the tunneling of roots through the rock media, and potentially its subgrade, plants and trees themselves will take up water through their roots, removing water from the tree trenches. This is not something that we can quantify at present, and is something that will change over time as the trees grow.