

3.9 Tree Wells

Soil Infiltration Range	Suitable for all soil infiltration rates; soils less than 0.8 in/hr (factored) require supplemental underdrain
Treatment Mechanisms	Interception, Infiltration, Evapotranspiration, Filtration
Maximum Drainage Area	This BMP is intended to be integrated into a project's landscaped area in a distributed manner, for all infiltration conditions. Typically, contributing drainage to a Tree Well will be less than 5,000 sq-ft for a large tree.

Description

Tree Wells are intended both to support the growth of healthy trees and to retain stormwater runoff. Tree Wells retain stormwater runoff via interception and evaporation of direct precipitation, and infiltration and evapotranspiration of runoff. Tree Wells also provide additional benefits from increasing tree cover including energy conservation, air quality improvements, and aesthetic enhancement.

When properly designed, Tree Wells can retain stormwater runoff from up to 10 parts impervious surfaces for each unit of Tree Well soil surface area. Many design variations may be used in Tree Well BMPs including the use of structural soil mixes and proprietary load bearing suspended pavement cells. Tree Wells are often adjacent to a curb or driveway. As with all stormwater BMPs, stormwater must be allowed to enter and distribute through the system. In order to provide these functions, Tree Wells must include an inlet of some form and a surface distribution system to allow water to flow over the surface of the soil and infiltrate into soil pores. Tree Wells also must include permeable soils to support healthy vegetation and infiltration of runoff.

Note: Proprietary Biofiltration BMPs such as Filterra and Modular Wetlands Systems do not qualify as Tree Wells as described in this Fact Sheet. Approval requirements for Proprietary Biofiltration BMPs can be found in the SMR WQMP.

Types of Tree Wells

Tree Wells may be designed in a variety of ways. They will typically fall into one of the three general categories:

- **Open Top Tree Wells** are those that do not contain pavement above any portion of the tree well soil. The distribution and ponding layers for this type of Tree Well are comprised of a shallow depressed area at the soil surface. This is the simplest configuration. This allows water to soak into the tree well soil by ponding over the surface. The depressed area should extend over the limits of the tree well soils that is being claimed for stormwater benefits.
- **Structural Soil Tree Wells** are those that support pavement or sidewalks above tree well soil that consists of structural soils that also permit healthy root growth. Structural soils are specially-blended to provide structural support for overlying pavement while also being supportive of healthy vegetation. Both proprietary and non-proprietary structural

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soils can be sourced from landscape and/or aggregate suppliers. The distribution and ponding layers for this type of Tree Well are provided by including a layer of open-graded gravel above the structural soil. This gravel layer permits rapid distribution of water over the surface of the structural soils and is also supportive of overlying pavement or sidewalks.

- **Suspended Pavement Tree Wells** are those that use structural cells to transfer the weight of overlying pavement to deeper soil layers, thereby permitting a volume of uncompacted soils to support healthy tree growth and infiltration of runoff. The distribution and ponding layer for this type of tree well may consist of either void space at the top of the structural cells or open-graded gravel located at the surface of the Tree Well soil below the top of the suspended pavement cell. Suspended pavement cells are typically proprietary systems.

Siting Considerations

Tree Wells work best when they are installed in relatively levels areas, but mildly sloped areas can be accommodated. Because Tree Wells are typically relatively small BMPs, they can be situated in many parts of a site, such as:

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances
- ✓ Rights-of-Way between roadway and sidewalks

Additionally, the use of Tree Wells as Self-Retaining Areas requires that the following siting guidelines be considered:

- Tree species must be appropriately chosen for the development. For public right-of-ways, local planning guidelines and zoning provisions for the permissible species and placement of trees should be consulted. Proper tree placement and species selection minimizes problems such as pavement damage by surface roots and poor growth.
- To reduce the potential for clogging of Tree Well soil, Tree Wells should generally not be designed to receive runoff from high sediment producing areas such as bare ground or high traffic roadways.
- Site grading must direct runoff from adjacent areas into Tree Wells if such areas are included as part of the Tree Well Self-Retaining Area.
- There must be adequate grade differential at the tree well inlet so that water can reliably enter the system during storm events.

Setbacks

Locations of trees planted along public streets must follow local requirements and guidelines. Vehicle and pedestrian line of sight must be considered in tree selection and placement. Unless exemption is granted by the Copermittee the following minimum tree separation distances (from the tree trunk) are required:

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- 20 feet from traffic signal and/or stop sign
- 5 feet from underground utility lines (except sewer)
- 10 feet from sewer lines
- 10 feet from above ground utility structures (Transformers, Hydrants, Utility poles, etc.)
- 10 feet from driveways
- 25 feet from intersections (intersecting curb lines of two streets)

If overhead utilities are located near a Tree Well, applicable tree selection guidelines should be followed. Such guidelines may permit that only certain shorter trees are permitted when overhead utilities are present.

Pretreatment

Pretreatment is not required for Tree Well BMPs; however, areas draining to BMPs should not include significant sources of sediment, which can lead to clogging of tree well soil pore space and reduce the stormwater benefit provided by Tree Wells.

Overflow

Tree Wells should be designed such that flows exceeding the retention capacity would bypass a given Tree Well and flow along a curb or gutter to an eventual storm drain inlet or another stormwater BMP. Because Tree Wells are usually small distributed BMPs, they are not required to include internal bypass piping connected to storm drains.

Design Criteria

To qualify as Self-Retaining Areas, all Tree Wells must be designed and sized according to the following requirements.

For configurations receiving flow via an inlet, where a portion of the tree well soil is below adjacent sidewalks, etc. the following criteria apply:

- **Inlet(s)** must be sized such that the runoff from the entire Self-Retaining area may flow unimpeded into the Tree Well during the 85th percentile 24-storm event. For Tree Wells with curb cut inlets, the cuts should be at least 18 inches wide.
- **Inlet Ponding Area** is an open water ponded area at the inlet location. It must be at least 10% of the total surface area of Tree Well soil area and must be at least 4 inches deep. It may not contain any gravel. The Inlet Ponding Area is intended to permit water to enter the system and flow into the distribution layer without premature bypass.
- **Distribution Layer** must be designed to permit rapid flow of runoff from the Inlet Ponding Area across the entire surface of Tree Well soil. The Distribution Layer must cover at least 80% of the total Tree Well soil surface area and must be level across the Tree Well Soil to permit even distribution. Distribution Layer materials and depths must conform to one of the following requirements:
 - Gravel Distribution Layers must be at least 12 inches thick and be composed of open-graded gravel. This layer may not be constructed using structural soil.

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Gravel Distribution Layers are most applicable to Structural Soil Tree Wells, but they may also be used in Suspended Pavement Tree Wells.

- If the distribution layer consists of open void space, this layer must be at least 4 inches thick above the Tree Well Soil. Void space Distribution Layers are used in Open Top Tree Wells and may be used in Suspended Pavement Tree Wells.

For all tree well configurations, the following criteria apply:

- **Extent of pooled water** must be at least 80 percent of the tree well soil claimed for stormwater benefits.
- **Tree Well Soil** must be at least 36 inches deep. Tree Well Soil should be reasonably permeable (target 2 in/hr) and should be Loamy Sand, Sandy Loam, Loam, or structural soil. Compaction of Tree Well Soil is only permitted for structural soils. The surface of the soil must be level.
- **Trees** should be planted close to the center of the Tree Well soil and should not be located on the edge of the Tree Well area.

Tree Wells may also include some of the following optional design elements:

- **Root Barriers** to prevent root growth near utilities, under pavement, or near other sensitive areas. At the discretion of [Insert Jurisdiction], Root Barriers may be required when Tree Wells are located next to specific types of infrastructure.
- **Surface Grates** to improve pedestrian access and prevent compaction of Open Top Tree Wells. Surface grates should not be used to support automobiles.
- **Underdrains** to help avoid prolonged saturation in cases where underlying soils have low permeability.

Sizing Criteria

To qualify as Self-Retaining Areas, the amount of area draining to the Tree Well may be no more than 10 times as large as the surface area of Tree Well Soil. This sizing has been developed to provide ponding and pore storage equal to 1.5 times the DCV as explained at the end of this fact sheet. Sizing factors may be limited to smaller allowable tributary areas at the discretion of the local jurisdiction.

Tree Selection

Trees that are planted in Tree Wells should be selected according to the following guidelines:

- **Local Climate:** Tree should be selected according to the local climate. Local landscaping requirements should be used to determine those trees that are appropriate. Trees should ideally be selected that require no irrigation except during initial establishment.
- **Mature Size:** Trees should be selected such that there are at least 2 cubic feet of Tree Well Soil for each square foot of mature tree canopy projection (at the drip line). This is the amount of soil that is required to support healthy trees. Smaller trees should be selected for smaller Tree Wells. If the minimum Tree Well Soil Depth of 36 inches is used, trees should be selected to have a mature canopy projection up to 1.5 times the surface area of Tree Well Soil.

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Maintenance

When appropriately sited and designed, Tree Wells should require relatively limited maintenance. Inspection and maintenance activities may include the following:

- Tree Health: Routine tree maintenance actions as necessary (e.g., pruning, watering young trees)
- Dead or diseased tree: Remove dead or diseased tree. Replace per original plans.
- Standing water in tree well for longer than 24 hours following a storm event: Loosen or replace soils surrounding the tree to restore drainage.
- Presence of mosquitos/larvae: Disperse any standing water from the tree well to nearby landscaping. Loosen or replace soils surrounding the tree to restore drainage (and prevent standing water).
- Accumulation of sediment in Tree Well Surface Ponding Area should be periodically removed to prevent clogging and to promote healthy trees without excessive sediment build up near the base.
- Trash and debris build up inlet or surface ponding areas: remove trash and debris.
- Entrance / opening to the tree well is blocked such that storm water will not drain into the tree well (e.g., a curb inlet opening is blocked by debris or a grate is clogged causing runoff to flow around instead of into the tree well; or a surface depression is filled such that runoff drains away from the tree well): Make repairs as appropriate to restore drainage into the tree well.

Sizing and Design Justification

This section does not apply to WQMP development. This section is included to provide the technical basis for the simple sizing factor of 10:1.

The following calculations support simplified sizing and design criteria for Tree Wells to maximize retention of runoff:

$$\text{Retained Runoff} = V_{\text{TW}} \times R_{\text{SOIL}} + \text{Ponding} = A_{\text{TW}} \times (D_{\text{TW}} \times R_{\text{SOIL}} + \text{Ponding Depth}) = A_{\text{TW}} \times (36'' \times 0.3 \text{ in/in} + 4'') = A_{\text{TW}} \times 14.8''$$

Where:

- Retained runoff equals the approximate runoff volume retained in a Tree Well
- V_{TW} is the volume of Tree Well Soil
- A_{TW} is the surface area of Tree Well Soil
- D_{TW} is the depth of Tree Well Soil
- R_{SOIL} is the retention of runoff in Tree Well Soil, as a volume fraction. R_{SOIL} is intended to represent the amount of water that is temporarily held by soil during storm events but then subsequently lost to evapotranspiration or to infiltration into underlying soil. This would include all water held by soil between saturation and permanent wilting point. A

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value of 0.3 is a conservative estimate assuming that Tree Well soil is Loam, Sandy Loam, or Loamy Sand texture.

The amount of runoff generated from a given impervious area during the worst-case 85th percentile 24-hour storm is calculated as:

$$\text{Impervious Area Runoff} = A_{\text{IMP}} \times D85_{\text{Temecula}} = A_{\text{IMP}} \times 1.0''$$

Where:

- A_{IMP} is the impervious area of the Self-Retaining Area
- $D85_{\text{Temecula}}$ equals the 85th percentile 24-hour precipitation depth at Temecula. Temecula was selected for this analysis because it has the greatest 85th percentile 24-hour precipitation depth in the developed portions of the SMR region (only the higher terrain of the Eastern Slopes exceeds this value).

For an I:P ratio of 10:1, the total loading to the Tree Well is 10 inches over the area of the tree well.

The retention depth over the tree well is 14.8" providing a retention volume approximately 1.5 times larger volume than the DCV. This ensures that the design would generally retain the DCV (if soil conditions allow) or provide biofiltration of 150% of the DCV if underlying soils do not allow for full infiltration and an underdrain is used.

Design guidance for Tree Wells requires that the surface distribution depth be at least 4" of void space or 12" of open-graded gravel. These minimums are intended to promote dispersion of runoff across the entire Tree Well soil surface and to reduce the likelihood of Tree Well bypass during more intense storms. This also helps assure that runoff has time to infiltrate into the pores of the tree well soil.