

CHAPTER
6.0 GUIDE:
**STREETSCAPE
ELEMENTS**

Trees and landscaping, lighting, pedestrian furnishings, paving, and other elements fill the spaces of the streetscape with life, light, color, and texture and make a street a comfortable, interesting, and usable space for people.



CHAPTER

6.0

STREETSCAPE ELEMENTS

- 6.1 Urban Forest
- 6.2 Stormwater Management Tools
- 6.3 Lighting
- 6.4 Paving
- 6.5 Site Furnishings
- 6.6 Utilities and Driveways

Streetscape elements are those functional and aesthetic items in pedestrian spaces that provide amenity and utility to pedestrians and other street users.

Streetscape elements discussed in this chapter include:

Urban Forest: All plantings in the right-of-way, including street trees, understory planting (ground landscaping), and above-ground planting (planter boxes and hanging baskets)

Stormwater Management Tools: Plantings, permeable paving, and other facilities to detain and infiltrate stormwater

Lighting: Both roadway and pedestrian lighting, including poles and fixtures, and light quality

Paving: Standard materials as well as special paving treatments

Site Furnishings: Other pedestrian amenities and functional elements, including: benches and seating, bicycle racks, bollards, flowerstands, kiosks and gateway monuments, newsracks, parking meters, public art, sidewalk restrooms, traffic and parking signs, trash receptacles, and wayfinding signage

Utilities and Driveways: Overhead, surface-mounted, and sub-surface utilities including all poles, trenches, boxes, vaults, vents, and valves, and driveways to access properties.

6.1 URBAN FOREST

The following section provides general principles that should guide how the City considers its urban forest, which includes all trees and landscaping. Recommendations for street trees and landscaping elements are provided in specific sub-sections.

Urban forest guidance will be further elaborated in the forthcoming Urban Forest Plan.

The urban forest includes any landscaping planted in the public right-of-way, including trees, understory plantings, and above-ground plantings. Planting in the public right-of-way enhances the physical, ecological, and cultural aspects of the city, including:

- **Environmental:** Trees and landscaping make important contributions to the urban environment by reducing air pollution, ameliorating urban heat islands, improving hydrologic conditions, sequestering carbon, and contributing to wildlife habitat.
- **Economic:** Trees and landscaping increase property values and can reduce maintenance costs of other streetscape elements.
- **Aesthetic:** The visual characteristics of street trees and landscaping (form, color, texture) add greatly to the

aesthetics of urban streets and can enhance the civic qualities of the public environment.

- **Psychological:** People derive psychological benefits from the symbolic and actual contact with nature provided by a green environment. A planted streetscape provides relief from an otherwise built out urban environment.
- **Social:** Opportunities for new social contacts, community identity, and the opportunity to contribute to the establishment and care of a community feature, are afforded by the presence of street trees and planting.
- **Safety:** Consistent tree plantings along a street narrow the perceived width of a street, encouraging decreased vehicular speed and increased awareness of pedestrians.

▼ Moraga Avenue

IN THIS SECTION: URBAN FOREST

Street trees
Understory landscaping
Above-ground plantings

Guidelines

Considering the Existing Streetscape

Trees and/or other landscaping should be added to existing sidewalks wherever existing width is sufficient to accommodate plant growth and recommended throughway widths per Section 4.2.

New street trees or landscaping should not result in an unobstructed sidewalk width of less than 48 inches on any street.

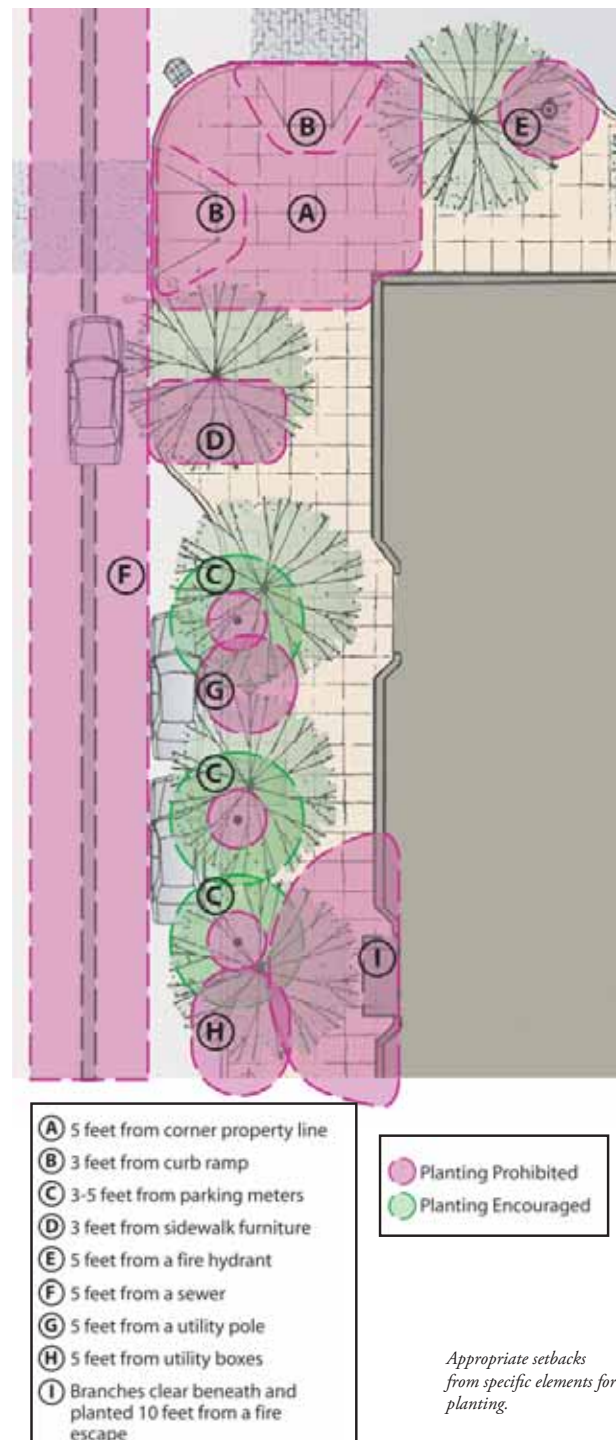
Location in relation to street parking along streets: Trees and landscaping should be kept out of the Edge Zone to protect them from car doors and overhangs and allow pedestrians to access their vehicles without conflict. In certain instances, street trees can be placed in the parking lane in-between parking stalls if sidewalk width is not sufficient or if a double row of trees is desired. See Section 5.6: Parking Lane Treatments.

Location adjacent to corners: When locating trees or landscaping in the sidewalk area near corners, they should be so located to assure visibility of traffic signals or signs. Trees should not be placed within 5 feet of the corner property line. Trees within 25 feet of corners should be pruned to 14 feet in height.

Utilities: Careful siting of trees and landscaping around existing above and below-grade utilities is important.

Minimum guidelines for sidewalk element clearance from street trees (not ground landscaping) on a public sidewalk are:

- Utility Boxes: 3 Feet
- Sewers: 5 Feet
- Fire Hydrants: 5 Feet
- Parking Meters: 3 Feet
- Sidewalk Furniture: 3 Feet
- Utility Poles: 5 Feet
- Gas and water meter and mains: 5 Feet
- Trees should be planted a minimum of 2 feet from the face of the curb.



Appropriate setbacks from specific elements for planting.



Landscaping of different sizes, colors, and types adds rich variety to the streetscape.

Many existing sidewalks can be retrofit to include simple but attractive planting areas



SOILS AND MICROCLIMATES MAP

THE COASTAL ZONE:

AREA 1 - Cool temperatures; foggy to clear days; light winds; sand and loamy soils

AREA 2 - Cool to moderate temperatures; foggy to clear days; light winds; sandy and loamy soils

AREA 3 - Cool temperatures; foggy; salt air; heavy winds; sandy soil

THE TRANSITION ZONE

AREA 4 - Cool to moderate temperatures; foggy to clear days; light winds; sand, clay, loam, rock soil

AREA 5 - Cool to moderate temperatures; clear days with light fog; light winds; sand, clay, loam, rock soil

THE BAY ZONE

AREA 6 - Moderate to hot temperatures; clear days; light winds; sand, clay, loam, rock soil

AREA 7 - Moderate to hot temperatures; clear days; heavy wind; sand clay, loam, rock soil

Selecting Plant Types

Street trees and other landscaping should be used to create a distinct character for specific streets and neighborhoods. Trees and landscaping should be designed in harmony with street lighting and sidewalk amenities and the building context. Trees and plants vary in their aesthetic appearance due to form, texture, foliar density/visual permeability, seasonal presence of flowers, growing season color, fall color, bark characteristics, and persistence of leaves (evergreen vs. deciduous). Aesthetic appearance should be taken into account in making design decisions for the public right-of-way. New planting added to existing streets should be in visual harmony with existing trees and planting. Selection of planting material should be used to enhance the identity of particular streets.

In view of global climate change, consideration should be given to future watering needs and heat resistance of species selected for planting. Landscape practices should follow xeriscape principles and drought-tolerant species should be used to meet the increased dryness associated with the anticipated future climate of San Francisco.

Plant material selection should account for performance in the urban environment, including drought tolerance and hardiness. Unfortunately, many native species do not do well in harsh urban conditions. Any plant species selected for planting should be adapted to soil and microclimate conditions and should serve an intended functional or aesthetic role. In some cases, the drought tolerant character of some native species may make them particularly suited for planting; however, past performance of the species in terms of durability, longevity, wind resistance, high branching to provide line-of-sight for pedestrians and vehicles must also be considered. Native plants and trees should be used when a native species is suited to the site and will serve the roles for which the planting is intended—generally, for stormwater plantings, areas of habitat value or connections, or for educational purposes.

Evergreen tree species should be used where it is desired to maintain foliage through the winter months or to enhance ecological performance by allowing leaves to slow stormwater during the rainier season. Deciduous trees should be considered for their ability to allow sunlight in the winter months and give shade in the summer, and for accent treatments.

Climate and Soil

Placement of trees and landscaping should reflect an understanding of local soil and climate conditions. Recommended trees for different San Francisco environments have been developed both by the Department of Public Works (Bureau of Urban Forestry) and the Friends of the Urban Forest in relation to the environments identified in the microclimates map, and will be identified in the forthcoming Urban Forest Master Plan.

Soil amendments can improve the longevity of trees and plantings in the streetscape and encourage natural stormwater infiltration. Soil amendments reduce soil compaction and improve soil functions, especially permeability. Soil amendments can also be used to improve the performance of planting strips, grass swales, bio-filters and filter strips. Soil amendments consist of organic matter that has a low-bulk density, such as compost, fly ash or peat. Soil amendment media can include compost, mulch, manures, sand, and manufactured microbial solutions. Natural compost, minimal slow release fertilizer, and soil conditioners may be appropriate for use where existing soil is badly degraded. The addition of organic matter that has a low-bulk density such as compost, leaf mold, partially rotted manure, or composted sewage sludge are examples of excellent, inexpensive soil amendments.

Soil amendments should be used where a soil cap and plantings are installed over an infiltration trench to enhance infiltration to the subsurface trench.

Engineered soils (for example structural soil), which can contribute to better tree health while protecting paved surfaces from root damage, may be appropriate in some locations.

Other Considerations

Stormwater management: The design of planting areas should consider including appropriate conditions for improved stormwater detention and infiltration. See Section 6.2: Stormwater.

Reuse of underused right-of-way space: Many spaces that occur within the public right-of-way may be considered for trees and other plantings. These spaces include traffic circles, excess space where two street grids intersect, parking lane planters, and other unique spaces. Trees and landscaping planted in these spaces should follow the considerations outlined in this section for species selection, spacing, and proximity to sidewalk and transportation features. In some cases, these ‘reclaimed spaces’ are suitable for the establishment of small groves of trees that can be planted at a greater density than would be appropriate for street trees. For more information, see Section 5.8: Pedestrian Priority Designs.

Culturally-sensitive plantings: The variety of cultural backgrounds of the people living in San Francisco should be considered in the selection and planting of trees in certain neighborhoods and adjacent to particular civic buildings. For example, in neighborhoods with a relatively high density of residents of Chinese descent, tree plantings might adhere to the principles of ‘feng shui’. Other ethnic groups place particular value on certain tree species and would like to see them planted in their neighborhoods. The San Francisco Friends of the Urban Forest have been sensitive to the concerns of different cultural groups and have made contact with practitioners of ‘feng shui’ and others for

advice on tree planting in certain neighborhoods. Outreach of this type to different cultural groups should be incorporated into site specific plans for tree planting in the public right-of-way.

Urban forest as habitat: A variety of native and exotic wildlife species make use of trees and landscaping in the city. Trees and landscaping provide cover, nesting sites, food, and in some cases, a source of water. Street trees and landscaping provide corridors for the movement of many species and serve as important links between parks and open spaces throughout the city. Future tree planting and street landscaping projects should consider existing linkages between parks currently provided by street trees and address gaps by locating new plantings in a supportive way. Consideration should also be given to the food value of different trees to wildlife. Certain tree species can play an important role as food plants for a number of birds and mammals living within the city.

Personal security: Personal security of people using the public right-of-way is influenced by trees, shrubs and their maintenance. Security is enhanced by situations in which trees and shrubs do not obstruct the view, interfere with street lighting, or block potential escape routes. Careful attention to tree pruning to ensure good street level visibility and avoidance of interference with street lighting is an essential part of the upkeep of trees in the public right-of-way. No box hedges should be permitted over 3 feet in height, which might obscure visibility or unnecessarily constrict paths of travel.



The reuse of underused spaces for increasing greenery on San Francisco's streets is a key strategy for improving the public realm and realizing a more sustainable City.



Trees and understory planting on a residential street add color and texture to the street

STREET TREES

Street trees are the most important organizing element of the streetscape environment. Appropriate tree species selection and location and design of the planting site will ensure the healthy growth and longevity of trees, enhance streetscape character, and maximize the City's investment. It has been demonstrated that street trees enhance property values in local neighborhoods.

➔ Placement

Street trees are typically planted in basins (sidewalk cut outs) in sidewalks. Where planting strips of sufficient width occur between sidewalks and streets, it is not necessary to create independent tree basins for trees. For most street typologies, ground-cover landscaping should be included in planting basins. In limited circumstances, trees may also be planted in above ground planters. Planting strips and above ground planters are addressed in the following sections.

🔧 Guidelines

Species Selection

The selection of tree species and their placement in the public right-of-way should be consistent with the goals of a particular street.

Ceremonial streets, commercial streets, major thoroughways, and other streets important to the city pattern should use formal, consistent planting palettes chosen for their distinct design qualities to provide a strong aesthetic character and facilitate place recognition. Neighborhood residential or smaller streets may use a more diverse, less formal planting palette to indicate neighborhood preference and create a rich planting variety.

Aesthetic value can be added through the use of consistent plantings, flowering species, and accent trees. The latter, distinguished by their contrasting color, texture, or size, should be used to alert motorists to approaching intersections or mark the entrances of city parks and plazas.

On formal streets with sufficient width, allées—a double row of trees—should be used to create a distinctive design.

Appropriate tree species selection should consider:

- Form, mature size, color, and texture to reflect the urban design goals of a street
- The mature tree canopy with respect to how it may affect street lighting or views of signage and building fronts
- The potential for root systems to affect sidewalks, curbs, and utilities
- Certain aspects of aesthetics are constrained by the particular climatic zone in which the site for a particular tree is located

Generally:

- Trees with columnar form are appropriate for narrower planting spaces such as small streets and alleys
- Trees with overarching canopies and medium density foliage are appropriate on wider streets, such as industrial mixed-use streets, thoroughways and boulevards
- Medium sized trees with light to medium density foliage are appropriate on neighborhood residential and commercial streets

Appropriate site-specific design decisions must be made on a case-by-case basis and should reflect aesthetic, economic, social, psychological, and environmental considerations, including those enumerated above.

Size

Minimum size requirements for trees to be planted in tree basins in the sidewalk are as follows:

- Caliper (trunk diameter) of trees to be planted should be a minimum of 2 inches at 8 feet of height (exceptions should be considered for desired species that may not attain this caliper size as a 24-inch box specimen)
- No branches should extend beyond the tree basin perimeter below 8 feet in height

- Minimum tree size at planting is a 24-inch box; 15-inch box specimens should be considered for volunteer efforts
- Overall, larger trees are recommended
- Tree branches that extend into the path of travel should maintain 80" of vertical clearance

Location and Spacing

Street tree spacing should be determined by the expected mature size of the tree. Generally, trees should be planted with the following spacing:

- Small trees (<20 feet crown diameter at maturity) should be planted 15 feet on center
- Medium sized trees (20 to 35 feet crown diameter at maturity) should be planted 25 feet on center
- Tall trees (>35 feet crown diameter at maturity) should be planted 35 feet on center
- Generally, trees with narrow crowns (less than 20 feet at maturity) should be planted at closer spacing while trees which normally develop broad crowns (> 40 feet at maturity) should be afforded wider spacing (e.g., 40 to 50 feet on center)

These guidelines may suggest a crowding of the canopies of adjacent trees, but trees will adapt to a slight degree of crowding and still remain healthy. Slight crowding will insure a continuous tree canopy along the street. Certain trees, such as palms and many ornamental species that may be used on ceremonial streets, will not result in a continuous canopy under most circumstances. Due to their nature as elements of visual rhythm, in the case of palms, or accent, in the case of ornamentals, planting spacing should focus on regularity as opposed to any specific distance; however under most circumstances, it should be 30 feet or less.

Tree spacing should create a continuous canopy and buffering effect between the roadway and the sidewalk. Closer spacing is desirable on heavily traveled streets to create a palisade view looking down the sidewalk.

These spacing guidelines should be considered general targets that may be adjusted to local street conditions such as set backs from corners, utilities, driveways, bus stops, building entrances, and specific tree species. To the greatest extent feasible, trees should be aligned with property lines in order to minimize interference with building entries, driveways, and utilities.

Where site constraints prevent maintaining an exact spacing, it is favorable to place a tree slightly off the desired rhythm than to leave a gap in the planting pattern.

Tree basins should be aligned so that the edges abutting the path of travel form a straight line along the block.

Trees adjacent to disabled parking and passenger loading zones:

Trees should not be placed in front of disabled parking signs. Street trees in disabled parking and passenger loading zones should maintain 8 feet minimum clear from curb face to tree basin edge for the length of the zone.

Trees at intersections: Trees are especially valuable to pedestrians at intersections. Without street trees, intersections can be overwhelmingly large expanses of asphalt. The need for trees must be balanced with concerns for sight distance and clear views of traffic control devices. Strategic placement and effective pruning of trees can vastly improve pedestrian and motorist conditions and safety at intersections.

In order to maintain driver site triangles at approaches to intersections, trees within 25 feet of the corner property line on approach and 10 feet of the property line on exit, as traffic flows, should be pruned to ensure a 14-foot minimum height of the lowest branch. The four trees at each intersection (one on each corner) should be large species that provide overarching canopies and high branching so as to maximize visibility and to visually enclose the intersection.

Street trees should not be planted closer than 5 feet on center from the property line at corners.¹

Trees adjacent to bus zones: Trees can provide welcome shade at transit stops and a continuous canopy along the street, but

CHARACTERISTICS OF TREES FOR DIFFERENT CLIMATIC ZONES

The city may be divided into three climatic zones: Coastal (Fog Belt), Transition, Bay (Sun Belt). The Coastal Zone is characterized by cool temperatures, dense summer fog, and prevailing westerly winds. This zone is best divided into a coastline and interior zone due to differences in wind exposure and salt laden air; consideration should also be given to the orientation of streets as east-west running streets generally experience more wind exposure. The Transition Zone has cool to moderate temperatures, light fog, sunny skies, and diminished wind velocities. The Bay Zone supports warm temperatures, skies that are dry, clear, and sunny, and generally light winds.

- General characteristics of trees best adapted to the Coastal Zone include trees of lower stature (up to 25 feet tall), evergreen species, and trees that are wind tolerant.
- Trees for the transition zone need some wind resistance, should be of medium stature (25 to 50 feet tall), and may be either deciduous or evergreen.
- The Bay Zone provides an environment more suited to a wider variety of trees. Trees that may be used include those of taller stature (over 50 feet tall) and those not noted for wind resistance, unless planted at higher elevation sites within the Bay Zone, which are subject to higher velocity winds (e.g., portions of Bernal Heights, Nob Hill, and Telegraph Hill).

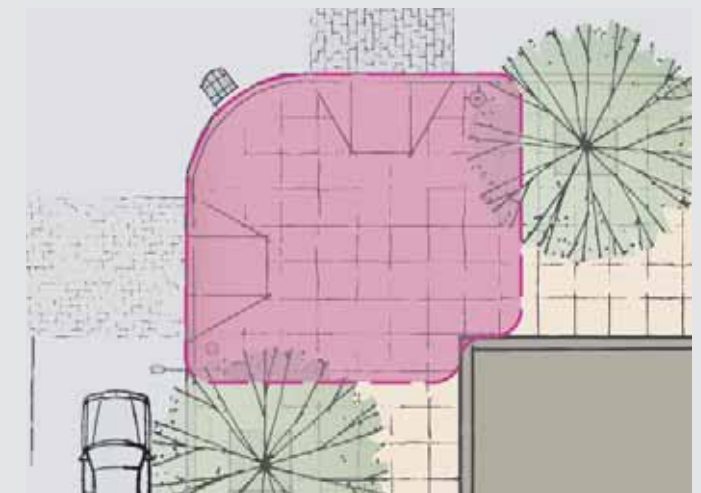


Figure 6.2. Tree planting at corners.

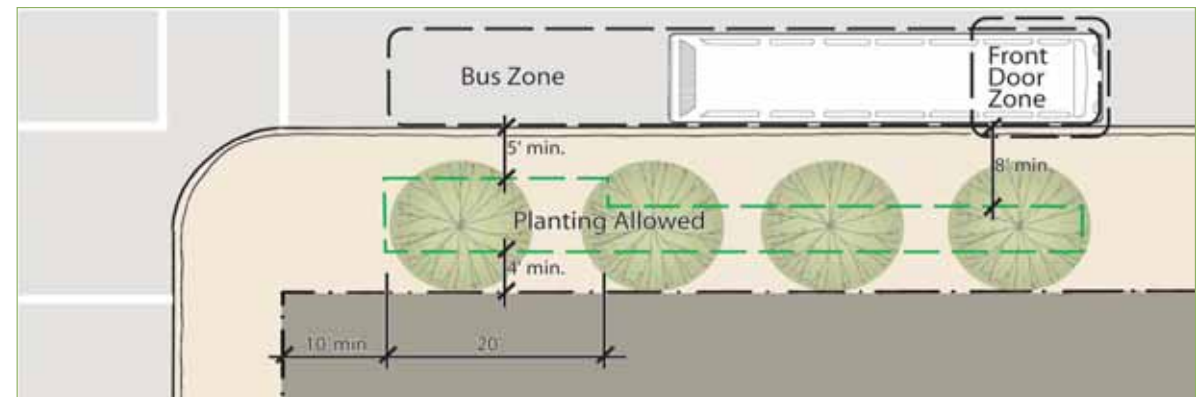
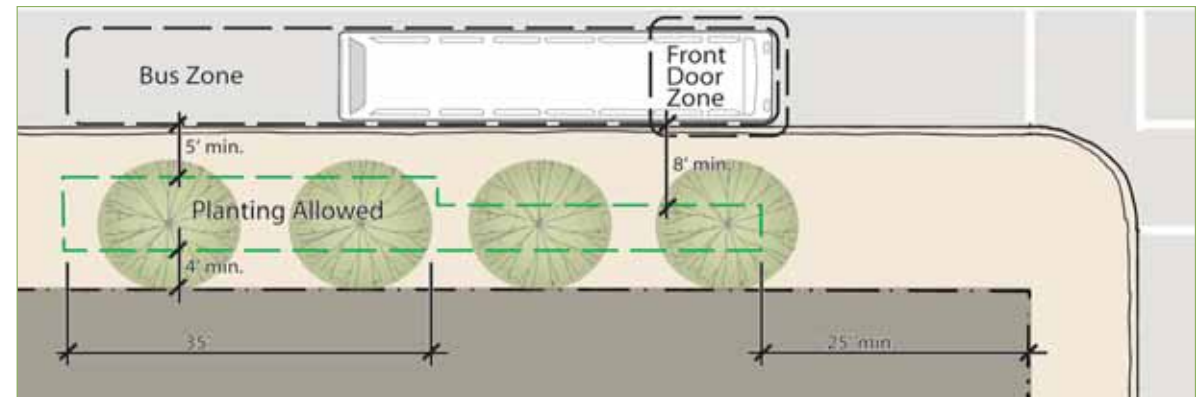
¹ Macdonald, Elizabeth et. al. *Street Trees and Intersection Safety*, UC Berkeley, November, 2006.



Tree Basins can be lined or edged in many different ways.



Tree planting in bus zones



they must be situated so as not to interfere with access to and egress from buses at bus stops. When planting trees adjacent to curbside bus zones, accommodations must be made for access to the bus doors. Trees should be planted in bus zones per the dimensions as shown above. Trees in bus zones should be placed in individual basins, or if placed in a continuous trench, the trench should be covered with an ADA-compliant surface material outside of immediate tree basins.

Trees in Medians: Trees should only be planted in median strips that are 4 feet or wider, including the curbs. Trees planted in medians should have either arching canopy structures that provide visibility without excessive pruning, or be upright and columnar in form. Tree species selected for planting on median strips that are 4 to 6 feet wide should be expected to grow to trunk diameters no greater than 12 inches. On median strips greater than 6 feet wide trees obtaining larger diameters may be used.

Trees in medians should follow the same spacing requirements as those on the sidewalk, but should, in addition, satisfy the following considerations:

- Should not be planted within 25 feet of the corner property line on approach to the intersection and within 10 feet of the corner property line on exit from the intersection, as the traffic flows. In these areas, groundcovers and shrubs less than 36 inches at maturity should be planted.
- Within 50 feet of an intersection, trees should be pruned to maintain a 14' clearance of the lowest branch

Coordination with street lighting: Street lighting should be coordinated with tree selection, placement, and pruning, so that canopies do not sit directly below street lighting. See Section 4.2. Overall Streetscape Guidelines, for detail. For new streets where lights and trees are being placed, street lights should be



Edging tree basins in special paving treatments results in a more visually interesting and attractive streetscape.

generally placed halfway in-between trees. When trees are being added to an existing streetscape, the basin pattern should respond to the location of existing lighting.

Trees and building projections: The width of the fire escape balcony, projected down to the sidewalk, should remain clear of any trees or landscaping. Awnings, canopies, signs, and marquees may also present conflicts with street trees. New projections should not compromise tree health or potential tree planting locations.

Size of Tree Basins

Trees need adequate surface area for root growth. Most tree species have the majority of their roots in the first 18 inches of soil. An important variable in tree basin design is the amount of surface area. Greater surface area provides for greater entry of water and oxygen into the soil.

Tree basins should meet the following sizing guidelines:

- Optimal size is 36 square feet per tree
- Minimum size is 16 square feet per tree
- In limited situations, small stature trees can do well in tree basins of less than 16 square feet. Tree basins of this reduced size exist at some locations in the city and should only be used for small trees unless room exists on the sidewalk for future enlargement
- Basins may be square, rectangular, or have other shapes to meet the minimum size requirements. For example, linear planters may enable a design to achieve optimal tree basin size on narrow sidewalks

Permeable surfacing may provide a way of increasing access of tree roots to water and oxygen when the optimal tree basin size is not possible. Continuous trenching between tree basins should be used wherever possible to maintain the capacity of oxygen and water to enter the soil in a tree basin, particularly where minimum sized tree basins must be employed.

Tree basin size should vary with the mature size of the tree species and soil conditions. Larger basins should be provided for larger trees.

Grade and Surfacing

Grade: Tree basin grade should be maintained at existing sidewalk grade. This grade may be maintained by topping the tree basin with decomposed granite (DG) or by covering the basin with sand-set paving stones or a metal grate. Preferred materials are sand-set pavers, cobbles, or DG.

Surfacing: Landscaping with drought tolerant groundcovers, small bushes, or grasses is encouraged within the tree basin, while open soil in basins should be discouraged. When landscaping is not used, the open basin area surrounding the base of the tree should be filled with sand set paving stones, cobbles or decomposed granite (DG) to maintain a level surface.

- Sand set paving stones or cobbles: Where sand set paving stones or cobbles are used, the basin cover opening should generally be the size of the root ball at planting.
- Decomposed granite: To account for settling of soil and DG, additional DG may need to be added during scheduled maintenance.

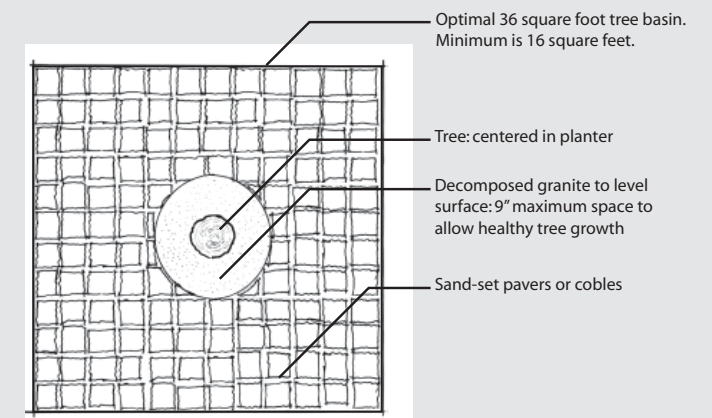
Tree Basin Furnishings

Tree Grates: Tree grates and other structural basin covers are generally discouraged, as over time, they can become an obstacle or tripping hazard and can interfere with the diameter growth of trees. Maintenance of tree grates is costly, often requiring metal-lurgists to expand the diameter of the opening as the girth of the trunk increases.

In limited locations, such as heavily traveled sidewalks where sidewalk width limits pedestrian movement at peak times, or where a formal design treatment is desired, such as along ceremonial streets, it may be necessary or desired to install tree grates to provide an adequate walking surface or design treatments. Grates should be designed with easily removable inner rings to allow for the growth of the tree trunk. Tree grates do not count toward the ADA minimum required 48-inch clear walkway.



Many tree grates are designed to be cut away as a tree goes, however are not properly maintained, resulting in tree girdling. Alternative strategies as described here should be considered.



Specifications for tree planting in a surfaced tree basin.



Trees in medians can provide a fuller canopy and visually narrow the street



Using cobbles or other paving stones protects the basin and still allows root access to water

Grates should have less than 1/2 inch spacing between rings to provide a safer walking surface and to prevent material from being trapped or falling into the basin.

Maintenance of grates used in high pedestrian traffic areas should include the periodic cleaning of grates and adjustment to eliminate any tripping hazard.

Tree guards: Tree guards are generally discouraged, but may be appropriate on heavily traveled sidewalks for the protection of newly planted trees. They are also appropriate adjacent to heavily used bus and light rail stops, around school buildings, and adjacent to other land uses with associated activities that may be considered detrimental to tree health and safety.

Tree guards should be of an attractive design, not possess any sharp edges, and made of durable material. Tree guards should be a minimum of 18 inches in diameter, and provide a minimum distance of 9 inches from the tree trunk at the time of planting. Tree guards are an opportunity to provide a special design for San Francisco and can incorporate public art.

Edging and Railings: Tree basins may be edged with low fences (<1 foot tall) where sidewalks have a minimum of 4 feet between the tree basin and a building wall. Such edging treatments are appropriate for residential and commercial neighborhoods with moderate to low pedestrian traffic.

Railings may be constructed of wood or wire, but rebar should not be used to avoid injury should a pedestrian fall onto them. Ornamental iron edging may be acceptable if it does not present any sharp edges that would pose a safety risk for pedestrians.

Edging the planting zone with a contrasting and/or permeable material such as cobbles or brick paving should be used as a design treatment. Edging enhances aesthetics as well as accessibility by clearly demarcating the basin edge.

Edging for tree basins should not interfere with accessibility of the soil surface or the tree for maintenance purposes. Nor should the edging prevent water from moving off of the sidewalk and into the tree basin. Edging should be designed to allow

rainwater from the sidewalk (in all cases) and/or the street (if specifically designed to do so) to flow into the planted area.

Where the base of landscaping is not at grade with the surrounding sidewalk, such as on sloped streets where planting is terraced and in stormwater infiltration planting areas, a 4 inch raised edging treatment should be installed around the landscaped area to delineate the presence of landscaping and grade change to people with visual impairments.

Maintenance

Pruning

- Pruning should be conducted under the supervision of a certified arborist
- On the pedestrian side of the sidewalk, the lowest branch that extends over the path of travel should provide an 80 inch minimum vertical clearance
- On the vehicular traffic side, the lowest branch should provide a 14-foot minimum clearance, where branches extend beyond the curb
- Newly planted trees should not have branches that extend beyond the perimeter of the tree basin below the 8 foot minimum vertical clearance
- Tree foliage should be maintained to provide a minimum 6-foot clearance from any public streetlight. Situations where tree canopies are topped below light standards should be avoided. Trees with taller canopies should be used or trees should be spaced so as to spread out between light standards.
- Tree foliage should maintain a safe distance from overhead high-voltage power lines as specified by the affected utility company
- Trees should be pruned for 1 to 2 feet of clearance to building façade and building signage
- Topping and severe pruning is not permitted
- Proper pruning and maintenance of trees should allow trees to develop healthily and retain their natural form

UNDERSTORY LANDSCAPING

Understory landscaping includes sidewalk planting strips and landscaping in tree basins. These are excellent ways to add green space to sidewalks where frequent pedestrian traffic between parked cars and the sidewalk is not expected or where a pedestrian path can be provided for people moving between the sidewalk and parked cars. This simple and inexpensive addition to the streetscape adds aesthetic, habitat, and ecological value to the city's right of way.

Understory landscaping:

- Reduces impervious area
- Naturally treats stormwater improving water quality
- Reduces runoff
- Provides infiltration and groundwater recharge
- Provides habitat
- Adds aesthetic value and promotes community stewardship
- Provides a buffer between the active pedestrian area of sidewalks and the street, enhancing pedestrian comfort

➔ Placement

Planting strips and sidewalk landscaping are suitable for most street types –residential streets, commercial streets, many thoroughways and industrial mixed-use streets. Planting strips can be located along sidewalks, in parking-lane planters, curb extensions, and medians.

More formal sidewalk buffer planting is generally appropriate for downtown, commercial, and special streets, whereas on residential streets plantings may have a more diverse character.

Planting strips can be located in most soil types, all micro-climates, and where topography limits slopes to <3%; where existing topography exceeds 3% planters can be “stepped” or terraced to achieve <3% slopes within the landscaped area.

⌚ Guidelines

The following section provides guidance on creating spaces for sidewalk landscaping beyond simply adding plants to a tree basin. Community sidewalk landscaping is permitted through DPW's Sidewalk Landscaping Permit.



A wide variety of plants can thrive in the local climate.



Planting areas should include paths to allow people to walk to and access vehicles without damaging plants.



Source: <http://www.flickr.com/photos/cottonrope/638333769/>

BEST PRACTICE: SIDEWALK BUFFER PLANTING CHICAGO, ILLINOIS

Sidewalk planters are commonly found throughout Chicago. On blocks with sufficient sidewalk width (as in the example shown below, from the Gold Coast neighborhood), planters are installed on both sides of the path of travel. Typically, a 12”–24” wide walkway is provided along the curbside to provide access to the parking lane and to accommodate small utility facilities and signposts.



Planting areas should include visually permeable edging at the beginning and end of the planted area.

Species Selection

In addition to landscaping, street trees are strongly encouraged in sidewalk planting strips if they are of sufficient width (a minimum of 3-4', depending on tree size). Street tree selection should follow the guidelines in the previous section.

Most plants are acceptable for understory landscaping; however, ivy should be avoided as it can provide protective cover for pests while larger bushes and hedges should also be avoided as they can limit visibility and accessibility.

Understory landscaping should use drought tolerant species. Deep rooted native or drought tolerant species have many benefits including tolerance to flooding and drought, low or no irrigation needed once established, improving water quality by filtering pollutants, and aerating and increasing the permeability of soils. Native and drought tolerant species provide wildlife habitat and generally contribute to the health of the soil.

Native or drought tolerant landscaping should be considered anywhere understory landscaping projects are implemented.

Planting strips can be designed to detain, cleanse, and infiltrate stormwater, and, in more significant storm events, overflow from one planter can be channeled to the next. For more information see Section 6.2: Stormwater. In most cases, a street does not require recrowning or other significant work to direct stormwater runoff to landscaped planters.

Location and Spacing

Planting strips should meet the following size requirements:

- Planting strips must maintain a 4' clear pathway for pedestrian through travel adjacent to the planting strip.
- Planting strips should be a minimum of 3' wide along a street where trees are to be planted. Narrower planting strips less than 3' wide may be used for other types of plants (e.g., shrubs, ground cover, grass).
- Planting strips may be installed adjacent to buildings. These may be as narrow as 1' and can be designed as

cut-outs in the sidewalk or can be an area used for planter boxes or other containers. This strategy is particularly relevant at transit stops where sidewalk landscaping should not be placed adjacent to the street edge.

Planting strips should not be installed in the following locations:

- Adjacent to an existing designated disabled parking or passenger loading zone, except plantings that maintain 8 feet of sidewalk through width
- Adjacent to an existing crosswalk
- In locations that impact curb ramps
- Within 2 feet of a fire hydrant in any direction

For larger-scale implementation, planting strips can be installed along a sidewalk between driveways and other amenities wherever width allows, subsequent to the following conditions:

- Minimum 3 feet for landscaping, and standard minimum throughway and edge zone requirements per Section 4.2. The throughway zone must retain a minimum 4 feet through width in all cases.
- The edge zone should be a walkable strip using either conventional paving or, preferably, pavers, DG, or other stable surface material that provides for infiltration of rainwater.
- Where on-street parking is uninterrupted by driveway curb cuts for more than two spaces (approximately 20 feet of curb per parking space), one walkable path for every two parking spaces should be created to provide access to vehicles. The path should be a minimum 48-inch wide and should pass perpendicularly from the curb to the sidewalk path of travel. The path should be located at the approximate boundary between two adjacent parking places. It may be made of traditional concrete paving, or porous concrete, pavers, brick, DG, or walkable landscape material to encourage infiltration. Where on street parking is uninterrupted for two parking spaces or less, adjacent driveway ramps should be used as the walkable path.

Planting Along the Property Line

On streets where there is not enough sidewalk space to install sidewalk landscaping in the Furnishing Zone or where sidewalk width allows, planting in the Frontage Zone should be considered. Property line planting strips that do not include trees may be as narrow as 12 inches.

Widened property line planting strips may contain trees if buildings along the property line are set-back from the sidewalk. Dimensions for planting strips and tree basins should follow the same sizing and other considerations as those located along the curb.

Shallow-rooted landscaping such as groundcovers, grasses and small shrubs should be used to minimize the risk of root damage to building foundations if there is no building setback.

Planting along the property line may also incorporate creeping vines and other similar materials to cover a building façade. Such treatments, called living walls or rain screens, can have stormwater management value as well (See Section 6.2: Stormwater).

Where the adjacent land use is a parking lot or includes street-fronting parking, hedges or trellises with vines should be used to screen these uses from sidewalk view.

Planting in Medians and in Parking Lanes

Understory planting should also be included in parking lane planters and medians.

Medians: Understory planting should be included in medians greater than 3 feet in width, including curbs. Trees and landscaping in medians is strongly encouraged wherever site conditions allow. Low maintenance, drought tolerant species are encouraged.

Parking lane: Understory planting should be included in parking lane planters with the same requirements as understory planting in sidewalk tree basins. See Section 5.6: Parking Lane Treatments.

Design of Planters

Other Streetscape Elements within Planting Strips

Parking signs, street lights, utility poles or other above-ground infrastructure located in planting strips should be set in concrete for adequate anchoring.

Planting strips should provide one 3' walkable path to mailboxes, trash receptacles, bike racks, and other street fixtures, not including parking meters.

Points of access to underground utilities must remain accessible through the plantings, but may be set within the planting strip. Areas that align with the planting strip but are not planted should be delineated by a sidewalk paving treatment or material that provides a visually contrasting surface. Materials such as DG or bricks or other paving material that varies from the sidewalk may be used.

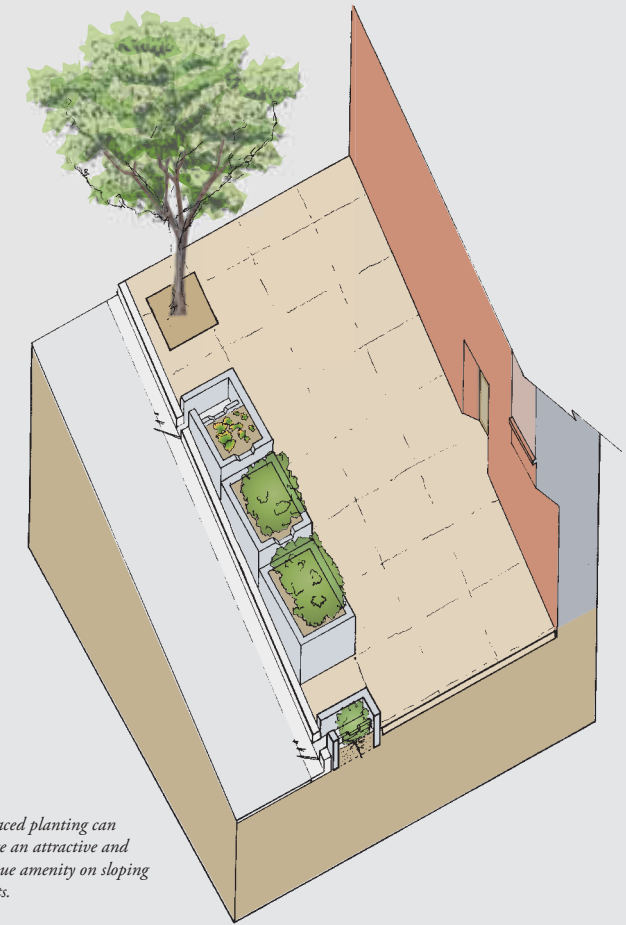
Terraced Planters

Planter strips should be terraced on sites with slope greater than 3% to avoid soil erosion and spillage on to the sidewalk. Landscaping and edging treatments should allow water to drain from the sidewalk into the landscaped area.

In areas with a known high water table and other subsoil issues, sites should be reviewed on a case-by-case basis as to their appropriateness for permeable landscaping. In such cases, an underdrain system should be used to drain the soil.

Planter Furnishings

See Street Trees: Tree Basin Furnishings, previous section.



Terraced planting can create an attractive and unique amenity on sloping streets.



There are a number of special opportunities for planting in contained soil media that can add attractive detail to the streetscape.

ABOVE-GROUND LANDSCAPING

There are a variety of types of above ground planters including potted planters, raised planter beds, hanging baskets, and other containerized bodies for trees and landscaping. Continuous and more substantial plantings in extended planter boxes can provide a buffer between the roadway and sidewalks, creating a more quiet and comfortable pedestrian environment.

➔ Placement

Above ground planters are appropriate for locations where existing sidewalk space or soil conditions do not allow for planting in the ground, such as where major utilities or basements beneath the sidewalk exist.

On downtown streets, commercial streets, and industrial mixed-use streets, above ground planters may be appropriate to delineate the edge of sidewalk seating areas or outdoor displays. On residential streets, residents may place potted plants along the sidewalk fronting their property. Many businesses and larger developments on all street types may include planters at street level as an architectural element, especially when integrating seating into the planter edge.

Raised planters should be considered an exception rather than a rule because of increased maintenance needs and inefficient use of resources.

⌚ Guidelines

Above ground planters should generally be a secondary alternative to more permanent planting in the sidewalk.

Container planting of trees

Trees planted in containers require high maintenance, show limited growth and vigor, and are often short lived. Container planting of trees is appropriate where trees are desired and where sub-grade conditions would otherwise preclude a tree.

Container plantings should follow the same spacing requirements for street trees as discussed earlier in this section. Piped irrigation should be provided. Planters should not be smaller than 16 cubic feet and should be constructed of durable materials that complement the design aesthetic of the street. Materials should be resistant to vandalism and damage from motor vehicles. Opportunities for incorporating seating into the planter are encouraged.

Raised planter beds

Raised planter beds can be incorporated into larger sidewalk elements such as seating areas. Placement should not reduce the clear right-of-way path of travel for pedestrians.

Hanging baskets

Hanging baskets can be added to a number of streetscape elements to add unique urban design detail and identity to a street or neighborhood. Use of drought tolerant perennials such as succulents is highly encouraged. Because hanging baskets are maintenance and resource intensive, they are not a preferred landscaping method. However, hanging baskets might be appropriate in some instances, such as where funded by CBDs or at important civic or ceremonial locations.

Rain Screens/Living Walls

Rain Screens, also known as living walls, are plantings on the exterior walls of buildings, that can add unique detail to a building and streetscape and serve environmental goals as well. Plants can be independent and hang from wall elements or can grow from property line planters or contained raised planter beds integrated with a building's architecture.

Rain screens can detain stormwater, allowing remediation of water pollutants and attenuating peak stormwater runoff. Implementation, sizing, maintenance, and benefits of rain screens are detailed in the forthcoming Stormwater Design Guidelines.

BEST PRACTICE: 12TH AVENUE GREEN STREET

PORTLAND, OREGON

This project, in downtown Portland and completed in 2005, involved converting the previously underutilized landscaped area between the sidewalk path of travel and the curb into a series of planters designed to slow, capture, cleanse and allow for infiltration of stormwater runoff. Using a landscape approach, the project manages the street's stormwater runoff on site instead of discharging it into the storm drain system, which feeds directly into the Willamette River. The project demonstrates how an existing urban street can be retrofitted to provide environmental benefits while being aesthetically pleasing.

How does the project work?

Runoff from 8,000 square feet of the street flows downhill along the curb until it reaches the first of four planters. The runoff is channeled into the planter through a 12-inch cut in the curb. In the planter, the water infiltrates into the soil at a rate of four inches per hour. In the event that water in the planter reaches a depth of six inches, it exits through another curb cut, flows back into the street and enters the second planter downstream.

The runoff will continue its downhill "dance" from planter to planter until all are at capacity. When all planters reach capacity, the water exits the last planter and enters the storm-drain system. The planters are able to manage nearly all of the street's annual street runoff, estimated at 180,000 gallons. A simulated flow test has shown that the planters have the ability to reduce the runoff intensity of 25-year storm events by at least 70 percent.



Raised planting beds create opportunities to integrate seating walls



Planters should be used to define the edge of seating areas within the sidewalk



Sub-surface infrastructure and conditions have a significant impact on streetscape design. What lies beneath the surface can be both a formidable constraint and a fantastic opportunity in terms of adding landscaping, green infrastructure, and other streetscape improvements.

6.2

STORMWATER MANAGEMENT TOOLS

NOTE: Technical design specifications for all stormwater management tools can be found in the “San Francisco Stormwater Design Guidelines.”

Concrete, asphalt, building roofs and parking lots all prevent rainfall from absorbing into the ground. Instead, this rainfall collects into runoff, accumulating chemicals, oil, metals, bacteria and other by-products of urban life. Left untreated, this polluted runoff contaminates the ecosystems of the Bay and the Ocean. Additionally, the hardening of the city’s surfaces keeps water from recharging groundwater aquifers, causing subsidence and other problems.

In addition, high quantities of runoff may also cause flooding and contribute to combined sewer discharges during large storm events. The tools presented in this section can help mitigate these environmental problems by removing or delaying the runoff stream and treating associated pollutants before stormwater is discharged into sewers and storm drains and, ultimately, to receiving water bodies such as the bay or ocean. For these

reasons, wherever it is possible to do so, water should be directed to stormwater features first, before entering catch basins. In addition to the ecological benefits that stormwater management tools can provide, these tools can be used to make the city’s streets more beautiful and enjoyable places to be.

This section presents stormwater management tools, individually referred to as “stormwater facilities,” that promote the advancement of Low Impact Design (see sidebar). These facilities have stormwater management benefits and contribute to streetscape aesthetics. The facilities are classified into broad types to help the user identify appropriate stormwater mitigation strategies for use within the range of street types.

Figure 6.1 presents the stormwater management tools described in this chapter and their typical functional benefits.

IN THIS SECTION: STORMWATER TOOLS

- Permeable paving
- Flow-through and infiltration plantings
- Swales
- Rain gardens
- Channels and runnels
- Infiltration and soakage trench
- Infiltration boardwalk

Shotwell Street ▼



CHAPTER 6: STREETSCAPE ELEMENTS

Figure 6.1
FUNCTIONS OF STORMWATER FACILITIES

	FUNCTION				
	Detention	Retention	Infiltration	Conveyance	Water Quality
Permeable Paving	○	○	○		○
Flow-Through and Infiltration Planters	○	○	○		○
Swales	○		○	○	○
Rain Gardens	○	○	○		○
Channels and Runnels				○	
Infiltration and Soakage Trench	○	○	○		○
Infiltration Boardwalks	○	○			

Choice of stormwater facilities should be based on the context of the surrounding streetscape (See Figure 6.2). These measures assume that a primary goal of the improvement is to mitigate stormwater effects; however they don't provide specific rainwater runoff performance goals. See the San Francisco Stormwater Design Guidelines for a more quantifiable mitigation goal.

Instead, this section is guided by the principle that in most cases, any stormwater mitigation is favorable, and highlights the relationship between these measures and other benefits such as streetscape aesthetics, habitat, and placement.

▼ LID prioritizes the use of smaller localized facilities, that improve streetscape aesthetics in addition to stormwater quality.



◀ San Francisco's Mint Plaza is designed with stormwater management in mind to convey stormwater through channels to a raingarden.

In addition to its impact on stormwater quality and quantity, multi-purpose design of stormwater facilities can add aesthetic value to the city by providing varied landscaping, visually appealing pavement design and enhanced community spaces on streets. They can also be combined with traffic calming features. Stormwater tools can add health and value to the urban ecology by enhancing the linkage of existing parkways and parks for improved aesthetics and neighborhood community spaces. In addition, these localized vegetated areas can create new habitat for wildlife, particularly birds and butterflies. Finally, by reducing total stormwater flows, the use of stormwater management tools may decrease the cost to the City of pumping and treating stormwater. The end result of implementing these street improvements is a more sustainable and attractive urban environment.

Definitions

Best Management Practice (BMP)

Operating methods and/or structural devices used to reduce stormwater volume, peak flows, and/ or pollutant concentrations of stormwater runoff through one or more of the following processes: evapotranspiration, infiltration, detention, filtration and biological and chemical treatment.

Bioinfiltration

A process that uses vegetation to capture and biologically degrade pollutants. Water is biologically treated while percolating through the system and into the existing soils, providing groundwater recharge.

LOW IMPACT DESIGN

Low-Impact Design refers to stormwater management that prioritizes the use of distributed control facilities that are typically landscape-based tools to not only reduce stormwater pollution and volume on-site, but also to provide ancillary benefits of improved greenery, place-making, and other aesthetic and quality of life related improvements. Low-Impact Design is also referred to as Low-Impact Development, Green Stormwater Management, and a number of other terms, however the City of San Francisco has elected to use the term Low-Impact Design to highlight the role of stormwater management as an important part of good public space and building design.



The Low Impact Design approach to stormwater management creates opportunities for unique and attractive streetscape design



▲ Multi-purpose design of stormwater management tools stresses creating stormwater infrastructure that also improves public space (Source: EPA Office of Water).

▼ Stormwater management can be a component of many other strategies elaborated in this plan, including remediating pork chop triangles (source: Kevin Perry)



Bioretention

A soil and plant-based retention practice that captures and biologically degrades pollutants as water infiltrates through sub-surface layers containing microbes that treat pollutants. Treated runoff is then slowly infiltrated and recharges the groundwater. These biological processes operate in all infiltration-based strategies, including the previously described retention systems.

Conveyance

The process of water moving from one place to another.

Green Street

A street designed to incorporate stormwater treatment facilities within the right-of-way. Green streets make visible a system of “green” infrastructure, incorporating the stormwater system and associated landscaping into the design of the neighborhood.

Design storm (Minor storm)

A design storm is a rainfall event of specified intensity and frequency that is used to calculate the runoff volume and peak discharge rate for the design of stormwater treatment facilities. The current design storm for San Francisco, known as the “5-year design storm,” requires that a stormwater facility be able to process 0.2 inches of rainfall per hour for 3 hours.

Detention

Stormwater runoff that is collected at one rate and then released at a lower rate. The difference is held in temporary storage.

Filtration

A treatment process that allows for removal of solid (particulate) matter from water by means of porous media such as sand, soil, or a man-made filter. Filtration is used to remove contaminants.

Infiltration

The process by which water penetrates into soil from the ground surface.

Low Impact Design (LID)

An innovative stormwater management approach with a basic principle that is modeled after nature: manage rainfall at the source using decentralized micro-scale facilities.

Major storm event

A rainfall event that is larger than the design storm. Although treatment facilities are not designed specifically to treat all the runoff from major storm events in the same capacity as a minor storm event, they must be designed to allow for the conveyance of larger flows without causing on-site flooding or erosion.

Peak flow

The point during a rainstorm where there is the highest volume of runoff in the city’s drainage system. Peak flow can be considered as the runoff ‘peak’ on a hydrograph.

Permeability/Impermeability

The quality of a soil or material that enables water or air to move through it, and thereby determines its suitability for infiltration-based stormwater strategies.

Retention

The reduction in total runoff that results when stormwater is diverted and allowed to infiltrate into the ground through existing or engineered soil systems.

Runoff

Water from rainfall that flows over the land surface that is not absorbed into the ground.

Sedimentation

The deposition and/or settling of particles suspended in water as a result of the slowing of the water.

➔ Placement

The stormwater management tools mentioned in this manual are highly customizable and can be integrated into a variety of different types of spaces in any of the street types. Opportunity sites include: the entire roadway and alley, corner and mid-block curb extensions, medians, pork chops, traffic circles and roundabouts, linear parking-lane and sidewalk planter areas and strips, streetscape plazas, along roadway and park edges, integrated into the front building edge, street trees, and even a simple stand alone raised planter.

Stormwater can also be used within landscaping or educational and art features. The designers of these facilities should look for opportunities to combine artistic elements, public art, and educational opportunities with stormwater management.

The following sections describe in more detail many opportunities to place, construct, and retrofit systems to include stormwater management tools into both new and existing streets. Figure 6.2 describes typical applicability of specific stormwater tools to individual street types.

🕒 Guidelines

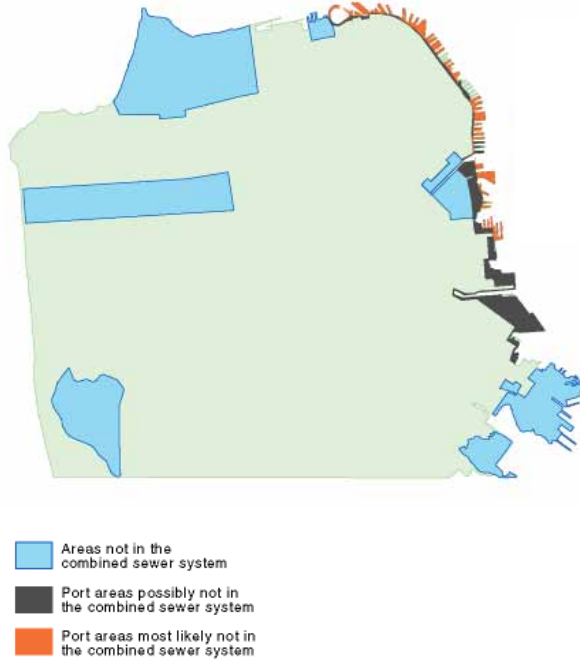
When integrating a stormwater treatment into a new or existing streetscape, designers should consider the objective of the installation. Where streetscape conditions allow, stormwater measures can be designed for conveyance, detention (peak rate control), retention (volume reduction), infiltration (groundwater recharge), and nutrient and sediment removal. (See Figure 6.1)

Figure 6.2
APPROPRIATE STORMWATER FACILITIES BY STREET TYPE

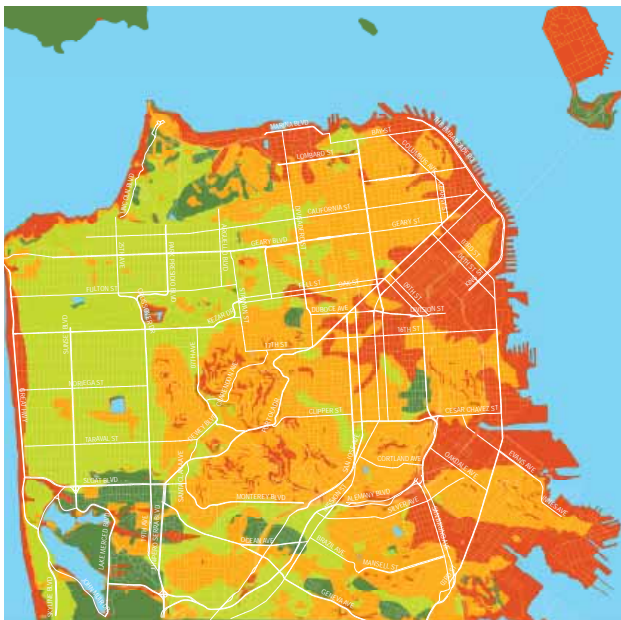
	COMMERCIAL			RESIDENTIAL			INDUSTRIAL		SPECIAL STREETS				SMALL STREETS	
	Downtown	Throughway	Neighborhood	Downtown	Throughway	Neighborhood	Industrial	Mixed Use	Parkway	Multitway Boulevards	Park Edge	Commercial	Alleys	Paseos
Permeable Paving	○		○	○		○	○	○	○	○	○	○	○	○
Flow-Through and Infiltration Planters	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Swales						○	○	○	○	○	○	○	○	
Rain Gardens	○	○	○	○	○	○			○	○	○	○		○
Channels and Runnels	○		○	○		○	○	○		○	○	○	○	○
Infiltration and Soakage Trench	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Infiltration Boardwalks	○	○	○	○	○	○			○	○	○	○	○	○



Stormwater management tools are highly customizable and can be designed in ways that are appropriate to a wide variety of contexts



San Francisco's topography and geology limit the applicability of some tools in certain areas of the City, and in all cases define the applicability of some infiltration-based tools, size and design elements critical to a successful stormwater management tool. In combined sewer areas, water quantity is the primary concern; in separate sewer areas, water quality is the primary concern.



The areas shown above roughly correspond to where infiltration may be possible, however a geotechnical survey will be necessary to determine whether infiltration and individual tools are appropriate to an individual site. See San Francisco Stormwater Design Guidelines for detail.

Site Constraints

Streetscape geometry, topography, and climate determine the types of controls that can be implemented. The initial step in selecting a stormwater tool is determining the available open space and constraints. Although the size of a selected stormwater facility is typically controlled by the available area of opportunity, the standard design storm should be used to determine the appropriate size, slope, and materials of each facility.

After identifying the appropriate stormwater facilities for a site, an integrated approach using several stormwater tools is encouraged. To increase water quality and functional hydrologic benefits, several stormwater management tools can be used in succession—called a treatment train approach. The control measures should be designed using available topography to take advantage of gravity for conveyance to and/or through each facility. Concentrating too much runoff in one area should be avoided.

Infiltration Considerations

Appropriate soils, infiltration media, and infiltration rates should be used for bioinfiltration and infiltration. A complete geotechnical report should be undertaken to determine infiltration rates, soil toxicity and stability, and other factors that will affect the ability and the desirability of infiltration.

Stormwater tools can be incorporated into areas of low permeability or where infiltration of stormwater is not desirable if special measures are undertaken. Underdrains should be used in areas where ponding is a concern. The location of the underdrain is an important consideration: if placed higher in a facility, the stored water below the perforated pipe will be infiltrated; if placed at the bottom of a sealed system, the perforated pipe will release the stored water slowly over time.

Minor details can translate into the ultimate success or failure of a system. For example, poor soils may cause conditions in which plants will not survive or stormwater runoff ponds or infiltrates too fast. Over-compaction or smearing of subsurface soil during excavation can lead to reduced infiltration capacity and flooding. The selection and specification of proper geotextiles is encour-

aged to increase structural stability, prevent erosion, and prevent facility clogging. The bottom surface of infiltration areas should be level to allow even distribution and good permeability.

The Infiltration and Soakage Trench tool details the design of infiltration systems within various stormwater facilities through structural detention systems such as oversized pipes and inline structural vaults. These systems are particularly valuable when combined with other stormwater tools.

Catch basins may also be designed with water quality filters, catch basin hoods and litter guards to help enhance the treatment of rainfall runoff.

Landscaping

Landscaping should be chosen to fit the specific type of stormwater facility and should be appropriate for the local climate and soils. In general, all landscape-based stormwater facilities should be planted with hearty, drought-resistant and water tolerant plantings that can survive periodic drought and inundation. Native, deep-rooted plantings or Mediterranean plants have been proven most effective.

Landscape features in stormwater facilities should follow the placement and clearance guidelines for Understory Plantings. See Section 6.1, Urban Forest

Streetscape Considerations

Utilities

Subsurface utility locations and building laterals are critical in determining the appropriateness of a particular facility, and must be factored into design considerations.

Pedestrian access should be maintained, while opportunities for consolidating or reducing the footprint of driveway curb cuts should be explored. Where a high number of driveways or utilities reduces the ability to implement stormwater management tools, median locations for stormwater facilities should be considered.

Accessibility

Standard requirements for sidewalk accessibility and clearances apply to planting areas and other stormwater facilities incorporated into the sidewalk. Specifically, stormwater facilities should follow these guidelines:

- Stormwater facilities that incorporate open planters, channels, or ditches should not be located in the through path of travel, at corners, or anywhere along the required accessible path
- Where stormwater facilities cross the path of travel, they should be covered by an ADA-compliant cover.
- Permeable paving systems in the path of travel should have no more than 1/4 inch gap between pavers
- Where there is a vertical drop between sidewalks and stormwater facilities (such as rain gardens, or channels), a 4-inch high lip should be provided at the edge of the facility for tactile detection.

Transit Stops

Certain stormwater facilities, such as those that use open planters or channels, are not appropriate within transit stops, except in limited locations. However, this does not mean that there is no possibility for stormwater treatment at transit stops.

Appropriate strategies near transit stops include: flow-through planters adjacent to buildings, covered channels or runnels, and permeable paving. Any drainage feature within a transit waiting area should be covered by a culvert, boardwalk, metal grate or similar feature.

All strategies used should maintain a clear path of travel to shelters and boarding transit vehicles, per Section 5.5: Transit-Supportive Streetscape Design.

Permeable Paving Systems

Permeable or perforated paving materials and unit pavers are an alternative to standard paving and help reduce stormwater runoff volumes by reducing impervious surface and providing temporary storage and or groundwater recharge through infiltration. By draining water, they may also reduce puddling and slip hazards. Permeable paving systems are typically surface paving systems that convey stormwater to an underlying uniformly graded aggregate base, where it is temporarily stored for either infiltration into subsoils or slow release to a storm drain system.

Permeable paving surfaces can be divided into two general categories based on application:

- Common pervious pavement surfaces typically laid on open-graded angular drain rock include: permeable unit paver block systems with joint gaps, pervious asphalt, and pervious concrete.
- For light-weight limited use areas, such as plazas or emergency access roadways, pervious pavement surfaces typically laid on non-compacted soil include: plastic systems planted with grass, and stone or pre-cast concrete blocks backfilled with gravel or sand.

Replacing standard pavement with permeable systems effectively reduces the city's impervious area by allowing runoff to infiltrate through the primary street surface, delaying and attenuating stormwater runoff. Absorbed water is temporarily stored in the rock base before being discharged through subdrains or infiltrating into the soil. Permeable paving can thereby decrease the cost of required on-site detention systems and downstream stormwater infrastructure upgrades due to the potential for stormwater runoff delay and volume reduction.

Permeable paving has also been shown to improve water quality by trapping pollutants, such as sediments and oils, within the underlying rock materials and by reducing the temperature of stormwater runoff before discharge to downstream systems.

HOW DO PERMEABLE PAVING SYSTEMS WORK?

- Pavers allow the surface to eliminate direct runoff by absorbing rainfall, letting water seep through the hard surface
- Water is temporarily stored in the subsurface volume of an aggregate layer that supports the pavement surface
- Water leaves the aggregate by either percolating into the ground (retention and infiltration) or by being drawn away through an underdrain if the subsoils are too saturated or impervious (detention).



Some permeable systems allow stormwater to flow between pavers, as shown above. Others provide a solid surface without gaps, nearly indiscernable from traditional materials.



▶ Permeable paving can make driveways not only help address stormwater but also contribute to streetscape aesthetics with unique textures and materials.

▼ On alleys, shared streets, and other streets with low traffic volume, permeable paving can be used as a special paving material to reinforce the pedestrian-oriented scale of these streets.



Permeable pavers can be used in many areas of the streetscape, and add attractive variety to typical paving. (Source: EPA Office of Water)

➔ Placement

Permeable paving systems are most appropriate for pedestrian-only and low speed and vehicular traffic volume areas with minimal pollutant spill potential, groundwater contamination, or dust and debris accumulation (which will impair infiltration capacity). Specifically, permeable paving is well-suited to seating and walking areas within the right of way, such as curb extensions, pocket parks, flexible parking lanes, or the furnishings zone of most sidewalks (See Section 6.4, Paving, for appropriate locations for special paving).

Permeable paving is also appropriate to low-traffic and low-speed (under 25 mph) roadways, such as residential streets and alleys or the parking lanes and driveways of other street types. Similarly, permeable paving provides a good alternate for limited use, regulated emergency access roadways or areas.

Although most permeable paving systems are at least as durable as typical concrete and asphalt, they are not suitable for high speed traffic or where heavy trucks are anticipated.

Permeable paving is most effective in areas of flat topography.

Permeable paving is not appropriate for high groundwater areas, areas sensitive to groundwater contamination, industrial sites, or land historically or currently used to store hazardous materials.

⌂ Guidelines

Design and Location

To minimize potential for failure or clogging, design of permeable paving systems should consider:

- suitability of the selected paving material for the site conditions
- strength of underlying subgrade
- required depth and storage capacity of base course
- surface and subsurface materials including filter fabrics

- installation method

Permeable paving requires an understanding of the prior use of a site. Site tests should be performed to determine soil conditions including: percolation rate and infiltration capabilities, depth to seasonal high water table, depth to bedrock, and soil contamination.

A separation of 3 feet above high water table and 2 feet above bedrock is required for proper performance. Permeable paving should not be installed over new or existing compacted fill.

Percolation testing to identify the infiltration rate of the native soil will determine the depth of base rock for the storage of stormwater, and whether an under drain system is necessary. In low-permeability soils, an underdrain should be included in the design. A permeable pavement underdrain system can also connect to other stormwater facilities such as rain gardens or infiltration swales.

Selected paving materials must be ADA-compliant, and not cause tripping hazards or excessive vibration. The use of unit pavers should be limited to systems with gaps of no more than 1/4" inch wide. Selected pavers should be smooth and durable with non-beveled edges. Beveled edges should only be used to mitigate vertical change, insofar as vertical changes are between 1/4" and 1/2" and do not exceed a slope of 1:2.

Both permeable pavers and porous concrete have the added benefit of elimination of Poly-Aromatic Hydrocarbon (PAHs) from the wastewater stream. Where porous asphalt is used, PAH free asphalt alternatives should be considered as a source-control measure.

Installation

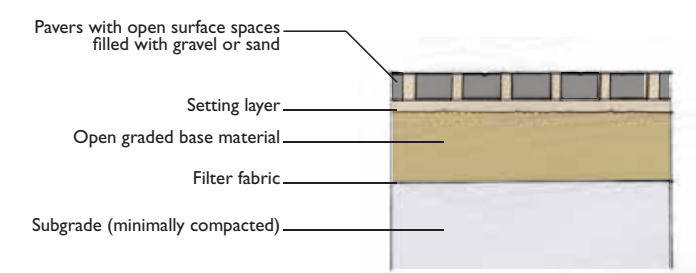
Pervious pavement is most susceptible to failure during construction. Special staging and installation phasing measures should be undertaken to prevent compaction, sealing, or sediment build-up. Specifically:

- Incorporate appropriate sediment reduction techniques wherever possible. Maintain erosion and sediment control measures until a site is stabilized.

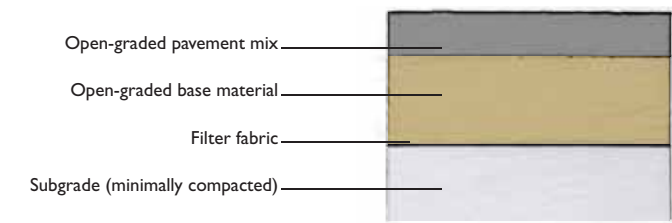
Sedimentation during construction can cause later failure of the infiltration systems

- Remove all compacted sub-base and avoid compacting soils during construction
- Spread the infiltration over the largest area feasible. Avoid concentrating too much street runoff in one area. A good ratio is 5:1 impervious area to infiltration area
- Avoid smearing of underlying soil, to minimize sealing of soils
- Avoid contamination with sediment; avoid tracking sediment onto pavement
- Avoid drainage of sediment laden waters onto pervious surface or into stone sub-base constructed bed
- Do not allow construction staging, soil/mulch storage, etc. on unprotected pavement surfaces
- Provide thorough construction oversight

Pervious Paver Systems



Pervious (Open Graded) Pavement and Asphalt Systems



The bottom sub-grade should be graded level to allow even distribution of infiltration where soil conditions provide for permeability. As required, under-drains should be placed at edge of pavement to provide drainage to prevent pond formation in the base.

Any currently paved area can be retrofit with a permeable system; the existing compacted or otherwise impermeable subbase should be fully removed to prepare the soil for infiltration, where possible.

Maintenance

With proper maintenance, permeable paving materials have a proven durability of up to 30 or more years: an increased lifespan over asphalt. All permeable surfaces require routine street sweeping using vacuum sweepers every 6 months and scheduled vacuum removal of gap pea-stones and joint re-filling every 5 to 10-years.

Trucks and other heavy vehicles should be prevented from driving on permeable surfaces wherever possible, and tracking and spilling dirt onto the pavement should be avoided.

Loose pavers should be fixed into position with a rigid edge.



Existing paving materials can be replaced with permeable systems in retrofit situations. (Source: EPA Office of Water)



▲ Stormwater planters can be part of the building frontage zone, where roof runoff is temporarily detained, and used as an amenity to add greenery to the streetscape.

▼ In many locations, planters can be used to infiltrate stormwater from the street and sidewalk.



Flow-Through and Infiltration Planters

Flow-through and infiltration planters are stormwater facilities that double as landscape features, but are designed to combine stormwater runoff control and treatment with aesthetic landscaping and architectural detail. These systems reduce the downstream potential for combined sewer overflows as well as improve water quality. Infiltration planters provide on-site retention and volume reduction through infiltration and groundwater recharge. Flow through planters provide runoff attenuation and rate control by delaying peak flows.

Flow through and infiltration planters are generally distinguished from rain gardens by having engineered soil and an underdrain.

- **Infiltration planters** are landscaped reservoirs used to collect, filter, and infiltrate runoff from roofs, streets, and sidewalks. This is achieved by allowing pollutants to settle or filter out as the water percolates through the planter soil media and into the ground. In addition to providing pollution reduction, flow rates and volumes can also be managed with infiltration planters. Planters should be integrated into streetscape design. Numerous design variations of shape, wall treatment, and planting can be used to fit the character of a particular streetscape.
- **Flow-through planters** are identical to infiltration planters, except that water is discharged through an outflow device instead of being infiltrated into the ground. They are particularly valuable as receiving bodies for roof runoff from downspouts when placed adjacent to buildings. Filtration and stormwater attenuation are the main design functions of the flow-through planter. Because they include a waterproof lining, flow-through planters are extremely versatile and can be incorporated into foundation walls along a building frontage. They may also be placed in the Furnishings Zone to receive runoff from streets and sidewalks through curb breaks.

Contained planters, such as pots or raised beds used for planting trees and shrubs, may also provide stormwater management benefit when placed over impervious surfaces. Contained planters

accept precipitation only, not stormwater runoff, but by reducing total impervious area they contribute to a street's reduction in total runoff. Planters can be placed on various surfaces, such as sidewalks, bulb outs and in the parking lane. Drainage typically occurs through the bottom of the planter and onto the adjacent surface. See Above Ground Plantings in Section 6.1, Urban Forest.

➔ Placement

Planters can be integrated into all street types and can be placed in the Frontage or Furnishings Zones. Because they can be effective even in small installations, planters are appropriate in constrained locations where other stormwater facilities are not possible.

Flow-through planters designed to detain roof runoff can be integrated into a building's foundation walls, and may be either raised or at grade. They are typically placed where building frontage meets the public right-of-way and sidewalk and can be designed to extend over the private property line. Such planters should be constructed along streets of minimal slope and terraced where street or sidewalk slopes exist.

On hillside locations, planters can be terraced along building faces or sidewalks, allowing for cascading surface drainage. Infiltration planters should only be considered in areas with sufficient soil infiltration rates and where groundwater is more than 10 feet below the surface. The use of infiltration planters should also be minimized on steep slopes or where there is high bedrock.

⚙️ Guidelines

Downspout planters

Flow-through planters adjacent to buildings should be a collaborative effort between the architect, landscape architect, civil engineer, and structural engineer. The structural basin of downspout planters can often be incorporated with building foundation plans. In addition, planters may be placed on either side of the property line under the City Sidewalk Landscape Permit program, which would allow larger planting bodies to receive

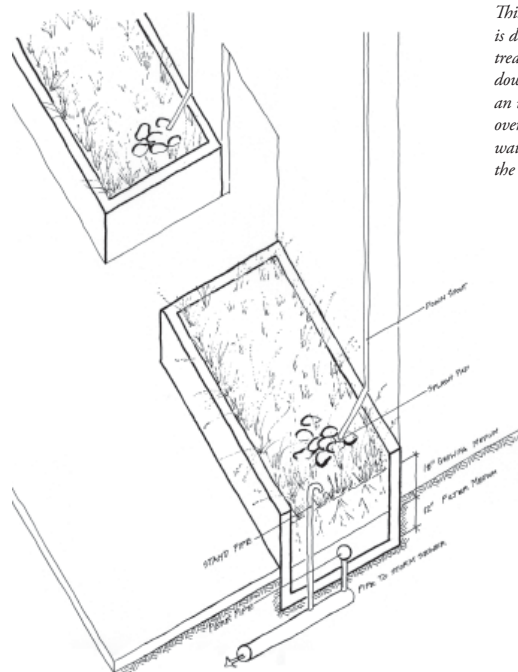
roof runoff. Wherever building-adjacent planters are present, roof drains should be designed to direct water to these features first. Planters must be structurally separate from the adjacent sidewalk to allow for future maintenance without disturbing the sidewalk. An expansion joint satisfies this requirement.

Building downspouts are typically discharged to the planter surface. Both underdrains and surface overflow drains are usually installed into the building planter systems. Building planters should be designed to pond water for less than 12 hours after each storm.

Minimum planter width should be 24 to 36 inches to accommodate underdrain systems, allow for planting room, and allow for constructability. They should be designed with 14" to 16" vertical heights to incorporate a seat wall.

Landscaping

Infiltration and flow through planters should follow landscaping clearances and guidelines for Understory Plantings. See Section 6.1: Urban Forest.



This flow-through planter is designed to accept and treat roof runoff from the downspout, and includes an underdrain and an overflow pipe to ensure water does not compromise the building's structure.

Swales

Street swales are long narrow landscaped depressions primarily used to collect and convey stormwater and improve water quality. They remove sediment and reduce nutrient concentrations within runoff through natural treatment prior to discharge into another stormwater management facility or the sewer network. In addition to providing pollution reduction, swales also reduce runoff volumes and peak flow rates by detaining stormwater. Swales add significant landscaping to street corridors and reduce impervious surface. Under some circumstances, rainwater infiltrates into the ground while being conveyed along the length of a swale.

Several forms of swales exist and are highly customizable. Natural swales are depressed linear features that combine appropriate plantings with amended soils. Bioinfiltration swales (or bioretention swales) typically include a subsurface infiltration trench below amended soil.

Placement

Swales are suitable for many street types with long, unconstrained areas, such as within medians or the outside edge of a street. Swales can be located in the furnishings zone of streets with un-broken curb edges, e.g. along streets without driveway curb cuts.

Swales can be connected with other stormwater facilities, such as rain gardens, to provide pre-treatment. Similarly, on parkways and other streets with adjacent open space, natural swales are an excellent form of treatment and runoff delay prior to directing runoff to a larger stormwater management facility or the city sewer network.

Swales are appropriate for virtually all soil types, but proper routing and design require a full understanding of local soil topography and climatic conditions.



▼ The parking lot swale at Sunset Circle on Lake Merced accepts and treats runoff from the parking lot.

▼ Swales may be appropriate on residential green streets, as shown below, as well as on parkways and other landscape streets, and in medians on many street types.





Swales can be used as landscape buffer. (Source: EPA Office of Water)

Guidelines

Design

The preferred width for swales is 5 to 11 feet. Swales as narrow as 3 feet may be appropriate.

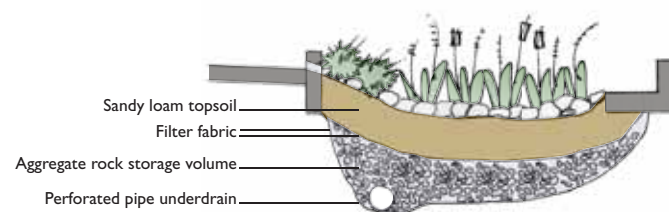
Side slopes and swale depth should be kept as mild as possible to avoid safety risks, improve aesthetics, and prevent erosion within the facility.

For swale slopes over 6% check dams should be provided and should be constructed of durable, non-toxic materials such as rock, brick, concrete, or soil by integrating them into the grading of the swale.

Swales can be incorporated into the urban setting by incorporating hard vertical edges to create a formal edge or raised safety border.

Flush ribbon curbs on the street edge of a swale or evenly spaced small curb cuts into the existing raised curb should be used to allow roadway runoff to enter swales.

Amended topsoil should be installed to increase filtration and to improve infiltration and retention of runoff. With appropriately amended soils, a vegetated conveyance swale can be combined with a subsurface infiltration trench. Where good infiltration rates exist, swales should be used in conjunction with subsurface infiltration trenches to further reduce both runoff volumes and peak discharge rates. In locations where there is low soil permeability, an underdrain should be considered.



Where swales are installed in medians, the adjacent roadway should be graded and crowned to drain toward the median swale.

Landscaping

Filtration benefits of swales can be substantially improved by planting deep-rooted grasses and forbs and by minimizing the slope.

Appropriately selected vegetation can improve infiltration functions, protect the swale from rain and wind erosion and enhance overall aesthetics. Species should be selected that will not require irrigation after establishment.

Swales should follow landscaping clearances and guidelines for Understory Plantings. See Section 6.1: Urban Forest.

Streetscape conditions

Frequent driveway curb cuts and sub-surface utilities may minimize the appropriateness of installing a swale.

Rain Gardens

Rain gardens are landscaped detention or bio-retention features in a street designed to provide initial treatment of stormwater runoff. Rain gardens are similar to flow through and infiltration planters, but generally do not have engineered soils or underdrains. Surface runoff is directed into shallow, landscaped depressions prior to discharge to the city collection system.

These planted areas are designed to incorporate many of the pollutant removal and infiltration functions that operate in natural ecosystems, and can provide any or all of the major stormwater management functions: detention, retention, infiltration, and pollutant filtration.

During minor storm events, runoff temporarily ponds in the facility and then slowly infiltrates downward through an amended and/or permeable soil subbase into the ground. Increased water quality is achieved by filtering pollutants through soil particles (which trap pollutants) and plant material (which take up pollutants). Ponding depths increase during larger storms until runoff overflows an elevated weir or drain outlet for discharge to the city storm network. An overflow riser with a domed grate should be included for larger storm events.

Rain gardens improve water quality by reducing sediment, nutrient runoff, and temperature impacts through natural treatment. Rain gardens can slow down the runoff and delay discharge, thus reducing and attenuating peak runoff rate within the city sewer. Furthermore, they can increase infiltration potential of a site and can provide retention through infiltration for groundwater recharge, thereby reducing total runoff volume.

The use of proper plantings combines landscaping with effective stormwater treatment, thereby reducing runoff rates and improving runoff water quality while contributing to neighborhood aesthetics and habitat value.

➔ Placement

Rain gardens can be implemented in a sidewalk furnishings zone of at least 4 feet in width and in a variety of streetscape configurations including: curb extensions, medians, pork chops, traffic circles and roundabout center islands, parking lane planters, and other geometries that create space for landscaping.

Rain gardens can also be used within various land use contexts in front of a home or building to capture rooftop runoff from disconnected downspouts.

Rain gardens are commonly used in conjunction with other stormwater facilities such as swales, formal channels, runnels, infiltration trenches, and sidewalk planting strips, but can also be implemented without these other features. Where infiltration boardwalks are considered, rain gardens can be planted between sections of boardwalk.

Rain gardens should typically be used where uncompacted soils and topography allow for moderate to good infiltration rates (0.05 and above inches per hour).

ⓘ Guidelines

Design

Where rain gardens are designed to infiltrate stormwater, a minimum 3-foot separation to bedrock and seasonally high water table should be maintained to prevent possible groundwater contamination.

An optional underdrain system should be considered where subsoil infiltration rates are moderate to low (less than 0.2 in/hr). A gravel trench with underdrain should be used to encourage drainage between rain events. In areas of limited soil permeability, runoff that has been filtered through rain garden soils can be collected in a perforated underdrain and conveyed to the city storm drain system. Similarly, within 10 feet of a building foundation soils should be lined and drained by an underdrain.



▲ Rain gardens are highly customizable, and can be designed to fit into any number of spaces within the streetscape. The above raingarden includes a channel, behind the pedestrian, to convey roadway runoff to the landscaped treatment area. (Source: Kevin Perry)



▼ Rain gardens can be placed in curb extensions on most street types.



Rain gardens can be part of medians, curb extensions, parks, plazas, and even typical streets. (Source: Kevin Perry)



▲ Channels direct water through hardscape, and are typically deep enough to allow a substantial volume of water to pass through.

▲ A runnel can be used for conveyance, carrying water across a hardscape to other stormwater management facilities. They are typically shallower, allowing them to be walked on during dry weather.

The depressed rain garden area should contain a surface layer of organic mulch, underlain by an amended soil plant bed that supports virtually any combination of flood-tolerant turf, grasses, shrubs, and trees.

An optional subsurface infiltration trench should include a uniformly graded bed with a perforated underdrain system. The subsurface storage/infiltration bed is used to supplement surface storage where feasible.

Roadway runoff should be directed into rain gardens by installing flush ribbon curbs on the street edge or small evenly spaced curb cuts into the existing raised curb.

Pre-treatment measures can help reduce the maintenance requirements of rain gardens and clogging of soils over time. Some pretreatment measures include: swales to filter out coarse sediments and debris, or a pea gravel border which acts to spread flow evenly and drop out larger particles.

The use of several small facilities, rather than one large facility provides a distributed infiltration area, and is preferable, where possible. The recommended ratio of impervious area to infiltration area, dependent on soil conditions, is 5:1.

Rain gardens should be designed to drain stormwater within 24 hours after a rain event to avoid concerns about perceived functional and public health risks. Ponding depths should be limited to 6 inches or less for aesthetics, safety, and rapid draw down within that time frame. Certain situations may allow deeper ponding depths up to 9", depending on location.

Surface side slopes should be as gradual as possible.

Deep rooted water tolerant plantings are encouraged to improve filtration and nutrient control benefits.

Landscaping

Rain gardens should follow landscaping clearances and guidelines for Understory Plantings. See Section 6.1: Urban Forest.

Channels and Runnels

Channels and runnels are concrete or stone lined pathways used to convey rainwater runoff along the surface to other stormwater control measures or the city collection system. Channels and runnels reduce the need for buried storm drains and to convey surface water where subsurface utility infrastructure prohibits the installation of additional storm drain piping. In addition to these benefits, runnels and channels add an attractive visual element whenever it rains.

Runnels are shallow systems usually designed for small spaces and conveyance of small to moderate flows, while larger and deeper channels are used for collection and conveyance of moderate to large flows. Both elements can add aesthetic, artistic, and educational features to a design by highlighting rainfall rather than quickly directing runoff to an underground piped system.

➔ Placement

Channels and runnels are suitable for most street types and open spaces. Channels can be incorporated as an aesthetic design element along sidewalk planting areas or within central medians. In curb extension construction, moving storm drain inlets can often be cost prohibitive. Channeling stormwater through a covered trench drain in the curb extension can allow the existing drainage infrastructure to remain, which may provide capital cost savings in some cases. See Section 5.3: Curb Extensions.

🕒 Guidelines

Channels and Runnels can be designed with a wide range of materials such as: unit pavers, bricks, recycled cobblestone, flat river rock, concrete, colored concrete, steel plate edging, or any durable impermeable material. Channels and runnels should be concrete mortared in highly urban areas for durability.

Where pedestrian crossing or accessibility is required, channels or runnels should be covered with decorative or durable linear trench drain grates, or small boardwalks at least 4 feet in width.

Runnels

Runnels are usually designed as an integrated element within street or plaza hardscapes. They should be located so as to minimize crossing of designated ADA pathways or emergency egresses. Where they do cross, a cover as described below (under Trench Drains) should be incorporated in design.

Typical runnels range from 10 to 36 inches wide and use contrasting material for aesthetic effect and improved differentiation by people with visual impairments.

Runnels should be designed with a smooth sloping cross section with depths not exceeding 2 to 2-1/2 inches for safety. Runnels should have a gentle slope of between 0.5% and 3% toward the outlet or discharge point.

On low volume streets such as alleys, runnels can be combined with soakage trenches in the center of the roadway to drain runoff by infiltration through the roadway center. This requires grading and crowining toward the center of the street.

Channels

Channels can also be integrated within street or plaza hardscapes for the collection of several small drainage areas. Under most circumstances, channels should have vertical hard sides with hard or natural bottom flow paths. Channels are usually deeper than 6 inches. They should be set back a minimum of 2 feet from the sidewalk or curb. Where an uncovered change of level is present within sidewalk or plaza areas, a 4 inch raised curb or border should be incorporated into the design to provide physical separation.

Channels should maintain a minimum slope of at least 0.5%, and the maximum slope in the absence of structural controls should not exceed 6%. Where steeper slopes are present, terraces or check dams should be incorporated into the channel design.

Covered Runnels or Channels (Trench Drains)

Where channels or runnels cross a pedestrian path of travel, a smooth ADA compliant cover, such as a steel grate, should be part of the design: this configuration is referred to as a covered channel, or trench drain. This treatment should be considered in locations where curb extensions are implemented to allow pre-existing catch basin location to be maintained, as a potential cost reduction strategy. Because of the increased importance of maintaining hazard free surfaces at transit stops, this treatment should be considered anywhere that stormwater must be channeled across transit stop areas, such as at transit curb extensions.

Where channels and runnels cross the main path of travel, the crossing must be at least 4 feet wide.

The bottom of the covered channel should be maintained at or below the grade of pre-existing gutter pan to preserve drainage to the storm drain inlet.

Trench grates should be a minimum of 12 inches in width to allow the majority of debris to move through the drain and to not severely limit the drainage capacity of the drain should debris build up.

Attractive grates should be used to provide an interesting urban design accent.

Grates or other access panels covering trench drains through curb extensions must be designed, installed and maintained so as not to pose an obstacle or tripping hazard.



Channel covers can use attractive grates and can be integrated with other site design elements.



This attractive architectural planter and fountain is a disconnected downspout that drains to a planter with an infiltration trench below.

Infiltration Trenches

Infiltration trenches are shallow subsurface linear stormwater facilities. They are typically 2 to 5 feet deep and installed in relatively permeable soils to provide on-site stormwater retention by collecting and recharging stormwater runoff into the ground. Trenches are typically backfilled with sand or coarse drain rock, and lined with filter fabric. The trench surface can be planted, covered with grating, covered with boardwalks, and/or consist of exposed drain rock or sand.

Depending upon the design, trenches allow for the partial or total infiltration of stormwater runoff into the underlying soil to achieve volume reduction. During small storm events, volume reduction may be significant and there may be little or no discharge. During large storm events, un-retained overflow should be provided by a gravity outlet.

The selection and use of infiltration trenches is highly dependent on soil type and height of the groundwater table.

Infiltration trenches can be effectively integrated into most of the other stormwater facilities described in this section to enhance function and stormwater mitigation capability of the other facility.

Temporary storage capacity of the system can be increased by installing multiple perforated pipes into a wide infiltration bed system.

Infiltration trenches are highly customizable with relatively low maintenance and can be incorporated with other stormwater tools. They reduce runoff volumes and rates through groundwater recharge and increase water quality by filtering pollutants and sediments.

Because of their narrow linear size, infiltration trenches can be installed as new or easily retrofitted into sidewalk areas or medians when not constrained by utilities.

➞ Placement

Infiltration trenches are typically linear systems that can be located under sidewalks, within sidewalk planting strips, beneath curb extensions, and in some circumstances beneath parking lanes. They are most effective when located beneath medians where a street is graded and crowned to drain to the median.

Infiltration trenches should be sited on uncompacted soils with acceptable infiltration capacity. They are typically recommended where appropriate soil and topography allow for moderate to good infiltration rates.

Infiltration trenches can be designed as a stand alone system or combined and integrated with other stormwater facilities such as: under roadside swales to increase storage and infiltration, under rain gardens to increase storage and infiltration, as part of an infiltration strip under conveyance gutters along lower volume streets such as alleys (typically covered with a permeable paver), or as a downstream retention system at the discharge end of most other stormwater management tools.

🕒 Guidelines

Infiltration trenches should be designed to minimize potential failure or clogging. The major components to consider during design include the use of a pre-treatment water quality inlet or sediment basin, adequate system piping, non-clogging filter fabric, clean and uniform aggregate drain rock, proper trench preparation, and adequate structure design for release.

Pre-treatment Structure

It is critical to design for stormwater runoff pre-treatment prior to directing raw runoff into a closed infiltration trench or gallery. A pre-treatment structure is designed to receive street runoff prior to discharging to the infiltration or soakage trench to minimize the entry of sediments and other debris into the system. Two forms of pre-treatment include a concrete water quality inlet (SF Standard Sand Filter) or a more natural planted sedimentation basin.

A water quality inlet with a minimum 18 inch sump is recommended for all surface drain inlets prior to discharge to a surface stormwater facility or sub-surface underdrain system. The inlet should be installed between the influent conveyance pipe and infiltration trench with perforated distribution pipe system. The infiltration trench should be installed a minimum of 5 to 10 feet from a building depending on whether a below grade dwelling space exists.

As an alternative, a small depressed natural sedimentation basin should be incorporated into the influent end of any stormwater facility to minimize long-term clogging.

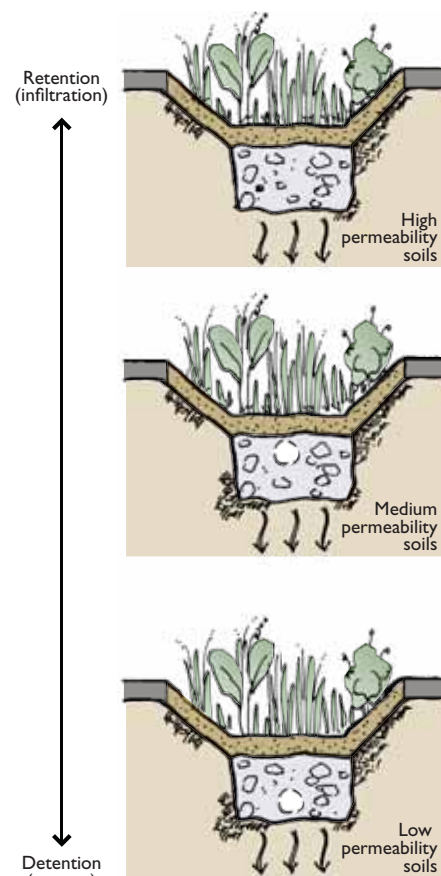
System Piping

The facility piping consists of 3 parts: an inlet pipe located between the sediment basin and the infiltration trench (or downspout or area drain), a perforated dispersion pipe located in the aggregate bed of the infiltration trench, and an outlet overflow pipe.

The inlet piping should be raised such that sediments in the pre-treatment structure remain trapped and do not transfer to the infiltration system.

Within the infiltration system, a continuously perforated pipe should extend the length of the trench and have a positive flow connection designed to allow high flows to be conveyed through the infiltration trench.

Based on the soil types and intended system function, adjustment to the perforated pipe elevation within the drain rock trench should be considered. For well draining soils, install the pipe near the top of the clean aggregate base to maximize infiltra-



tion. For moderate draining soils, install the pipe near the bottom of the clean aggregate base to minimize infiltration while still attenuating runoff through temporary storage.

Cleanouts or inlets should be installed at both ends of the infiltration trench and at appropriate intervals to allow access to the perforated pipe. Monitoring wells are recommended (and can be combined with clean-out). The discharge or overflow from the infiltration trench should be properly designed for anticipated flows.

Trench

The slope of the infiltration trench bottom should be designed to be level or with a maximum slope of 1%. A level bottom assures even water distribution and infiltration. The trench and perforated pipe should be installed parallel to the contour of the finished grade. If moderate ground slope exists, the trench may be constructed as a series of steps or with clay check dams if necessary.

Installation

Prior to design of any retention or infiltration system, proper soil investigation and percolation testing should be conducted to determine appropriate infiltration design rates. During the site layout of the facility there should be no less than 3 feet of undisturbed depth of infiltration medium between the bottom of the facility and any impervious layer (hardpan, solid rock, etc.) or seasonal high groundwater levels (for water quality protection).

Infiltrations trenches should be installed parallel to the contour with maximum ground slopes of 20% and be located no closer than 5 feet to any building structure. Compaction of soils should be avoided during construction.



Infiltration trenches can be located beneath other stormwater management tools, such as permeable paving or landscaped facilities, to increase storage capacity for infiltration.





Top: This apartment building uses boardwalks over an infiltration area to define unique entrances to each unit from the shared street. Note that the shared street is also paved in attractive pavers.

Bottom: Pathways across pocket parks and other large open space areas in the right of way can be raised to allow infiltration below.



Photos by Sherwood Design Engineers

Infiltration Boardwalks

As an alternative to exposed landscape stormwater facilities, segments of sidewalks or reconstructed curb extensions may be retrofitted with durable boardwalks to serve as clear pedestrian thoroughways integrated with stormwater management. Raised boardwalks may be placed over exposed drainage rock or amended engineered soils to allow stormwater to pass beneath a walking surface for temporary storage or infiltration into the soils below.

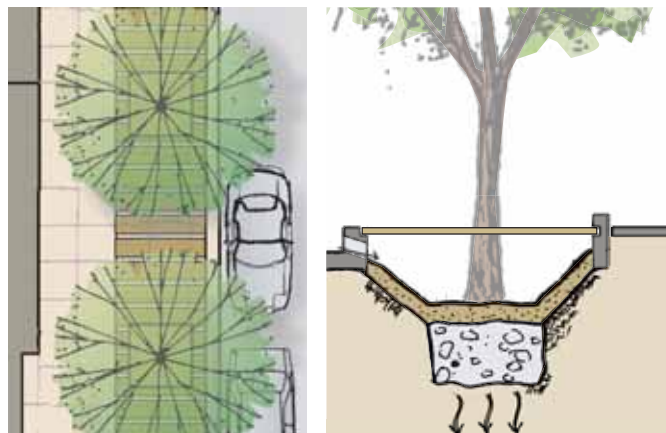
A boardwalk creates an exposed soil or a gravel infiltration trench beneath the sidewalk that effectively reduces impervious surface area and provide opportunities to infiltrate runoff from the public right-of-way, without losing valuable pedestrian space.

These infiltration areas cleanse and infiltrate stormwater runoff to the groundwater, decreasing the burden on stormwater infrastructure without reducing valuable pedestrian space.

Boardwalks can add interesting diversity of color, texture and material to the sidewalk and create possibilities for landscaping or educational uses.

Left: Boardwalks could be used as a sidewalk treatment in the furnishings zone, or on curb extensions.

Right: An infiltration trench below the boardwalk would allow roadway runoff to be detained and treated and potentially infiltrated. Infiltration basins can alternate with tree basins beneath the boardwalk to preserve street tree planting, or structural soils can be used to serve as both an infiltration and tree planting medium.



➔ Placement

Boardwalks are best suited for flat streets.

Portions of new curb extensions that are not within the main path of travel for crossing the street should be considered for installation of boardwalks to create additional roadway edge and furnishing zone areas of the sidewalk. The thoroughway and frontage zones are not appropriate for this treatment.

Infiltration boardwalks are not recommended adjacent to curbs that serve as transit stops.

↻ Guidelines


Boardwalks may continuously cover infiltration areas or, where increased landscaping is desired, sections of boardwalk can be removed and infiltration areas can be planted with rushes or grasses, resulting in a rain garden.

Boardwalks should be flush with existing sidewalk level in order to reduce tripping hazards and maintain a sense of one continuous pedestrian realm. Like rain gardens, facilities placed in series would allow overflow from one infiltration area to be captured by the following during larger rain events, with an ultimate outflow to the nearest stormsewer system inlet.

A pre-treatment forebay should be located between each curb cut or channel entrance and the below grade infiltration system to collect street debris and allow particulates to settle out to minimize maintenance. When planting is not desired under boardwalk sections, the top surface should be design with drain rock.

Sign poles, utility access panels, and pedestrian amenities can all be maintained within the boardwalk area with appropriate clearances (See Site Furnishings, Section 6.5).

Boardwalks should have accessible surfaces. They should leave gaps of no more than 1/4 inch.



Street lighting is a key organizing streetscape element that defines the nighttime visual environment in urban settings. Street lighting includes roadway and pedestrian lighting in the public right-of-way.

6.3

LIGHTING

Street lighting is a key organizing streetscape element that defines the nighttime visual environment in urban settings. Street lighting includes roadway and pedestrian lighting in the public right-of-way.

Quality streetscape lighting helps define a positive urban character and support nighttime activities. The quality of visual information is critical for both traffic safety and pedestrian safety and security. Lighting should be designed not only for vehicular traffic on the roadways, but also for pedestrians on sidewalks and pedestrian paths.

➔ Placement

Pedestrian lighting should be prioritized in the following locations:

- Streets with high pedestrian volumes
- Key civic, downtown, and commercial streets
- Streets with concerns about pedestrian safety and security, such as at freeway underpasses
- Small streets such as alleys and pedestrian pathways



Guidelines

Location and Spacing

Street lighting poles should be located on the sidewalk close to the curb on the curb side edge, or centered within, the Furnishing Zone. Typically, pedestrian lighting poles align with the street lighting poles. However, on very wide sidewalks pedestrian lighting poles may be farther from the curb than the street lighting poles to light the primary walkway.

Relation to other streetscape elements: Pedestrian lighting poles should be located between street lighting poles. All lighting poles should be coordinated with other streetscape elements. Utility equipment above and below ground, such as pull boxes and underground trenches, should be coordinated when locating lighting fixtures.

Light fixtures should not be located next to tree canopies that may block the light. When determining tree type, anticipated height and diameter of the tree canopy should be considered relative to lighting fixture height and spacing based on light level and uniformity requirements. Appropriate distance between the tree and lighting fixture depends upon the type of tree and type of lighting fixture. If blocking the light output of the fixture cannot be avoided due to existing locations of the lighting fixture and trees, consider adding additional lighting fixtures to mitigate the shadows from the tree canopy.

Light Distribution

Light fixtures should be selected to efficiently direct light to the desired area of the roadway and sidewalk. Lighting fixtures should be selected to enable a variety of light distributions to adapt to different street and sidewalk configurations while maintaining the same fixture appearance. The distribution type should be selected based on street and sidewalk width. Glare should be mitigated by selecting the proper lamp wattage and mounting fixtures at the appropriate height.

Sky glow is a consequence of several components of lighting: light directed to the sky from lighting fixtures and light reflected off the ground. Light trespass is light that enters an area where it

is not wanted, such as street light entering a residential property. Both sky glow and light trespass can be detrimental to the environment and irritating.

Sky glow should be mitigated by selecting dark sky friendly lighting fixtures that direct most of the light downward, by eliminating excessive light level, and by turning lights off when not needed. Light trespass should be mitigated by specifying the correct light distribution. If necessary, house-side shields may be used on fixtures to minimize light trespass into residences or other areas.

Lighting fixtures should not be located close to windows to avoid light trespass or glare and disturb the adjacent building's occupants.

Light Color

The color of the nighttime environment is dependant upon the light source. Metal halide, induction, and fluorescent lamps create a relatively white light compared to the yellow of high-pressure sodium lamps. Color identification is easier and clearer under white light sources. There is also emerging data that peripheral vision is improved with white light sources.

Typically, high-pressure sodium lamps are used throughout the City for their long life and energy efficiency. White light sources are currently used in some areas and may be used in future development where more accurate color identification is desired or for areas that need color differentiation. For example, metal halide should be utilized on streets with high nighttime pedestrian activity. However, as metal halide lamp technology continues to improve and as new technologies such as LED become readily available, white light may soon equal or surpass high pressure sodium in these advantages.

Light Fixtures

Street lighting fixtures illuminate both roadway and sidewalk and are typically 20' to 30' high. Typically, the taller the pole height the larger the area each lighting fixture can illuminate. This means that the spacing between lighting fixtures can be wider and fewer fixtures can be used to light the street, which is economical for construction and maintenance.



Light fixtures are an important visual element of a street not only because they provide light at night, but also because they set a strong visual rhythm and can reflect a specific style or aesthetic.



Pedestrian scale lighting fixtures better light the pedestrian way, providing an improved sense of security and comfort.



Building mounted pedestrian lighting should be encouraged in commercial districts.



Downward-facing lighting prevents excess light from trespassing into adjacent buildings.

Pedestrian-scale lighting fixtures, typically 12' to 15' high, illuminate pedestrian-only walkways and provide supplemental light for the sidewalk. Pedestrian-scale fixtures should be encouraged to improve pedestrian lighting on key streets. Pedestrian-scale fixtures should be considered in areas with high nighttime pedestrian activity and/or with wide sidewalks. Pedestrian-scale lighting fixtures should also be considered for narrow streets, including local access lanes, alleys and pedestrian pathways, that can be adequately illuminated with these fixtures alone. In these situations, street lighting fixtures will most likely be required at intersections, and for the through lanes of a multi-way boulevard in the case of local access lanes.

The city should explore opportunities to encourage property owners, private developers, and public buildings to install wall mounted or suspended pedestrian lighting fixtures for sidewalks, small alleys or pedestrian-only streets where conditions allow.

Light Poles and Fixtures

Lighting fixtures should be selected that are appropriate to the overall streetscape style and identity of the neighborhood and that maintain continuity between the different streets in the neighborhood. Neighborhoods should have a consistent fixture style to present a unified appearance, and similar neighborhoods around the City should have the same or similar fixture styles. Accessories such as banner arms may be added to light poles to further identify the neighborhood.

To create a unified palette of fixtures throughout the City, with managed flexibility for unique neighborhood improvements, a coordinated lighting master plan should be undertaken to develop standards for appropriate fixtures and more detailed location and technical criteria.

By day, the style of a lighting fixture has significant impact on the character of a neighborhood. By night, the light distribution of a fixture will define the visual environment and the lighting fixture itself may be a design element in the streetscape. Both day and night characteristics of a lighting fixture should be considered when selecting appropriate fixtures for a neighborhood.

Lighting fixtures with an opaque top, no glowing lens (without features to make the fixture dark sky friendly), and an optical system that directs all light downward, such as a flat lens “cobra head,” present a low profile at night and direct attention to other elements in the streetscape. This type of light fixture should be prioritized on residential and small streets.

Fixtures that have a glowing lens such as a “teardrop” or “acorn” will be a visible element and a prominent part of the streetscape at night. There are decorative and historic advantages to using a lighting fixture with a glowing lens, but the fixture should be dark sky friendly and direct most of the light downward. This type of light fixture should be prioritized on civic or commercial streets.

Lighting fixture elements such as the pole and lamp should be proportional to each other, and their scale should be balanced with the surrounding building and roadway context.

The rhythm of the lighting poles should be consistent in a given neighborhood. On wide streets, lighting fixtures should be located on both sides of the street, and can be staggered or parallel depending upon lighting level and uniformity considerations. Light poles should have a consistent spacing with regard to trees and other street poles.

Where possible, street lighting should be combined with traffic light or Muni poles to reduce the quantity of poles on the sidewalk. However, light level and uniformity requirements should take priority over pole consolidation. In cases where roadway lighting fixtures alone do not provide adequate pedestrian lighting, pedestrian lighting fixtures should be added between roadway lighting poles; pedestrian lighting fixtures should be attached to roadway lighting poles where this achieves the intended lighting level and uniformity.

Energy Efficiency

Energy efficient lamps produce a higher light output per watt than non-energy efficient lamps. In addition to the lamps, energy efficient fixture designs should be specified. A good opti-

CHAPTER 6: STREETSCAPE ELEMENTS

cal system directs light to where it is needed and optimizes light output and should be used. Fixtures that direct light primarily downward toward the street rather than up toward the sky should be selected.

For further energy savings, the City may select to turn off certain lights later in the evening. For example, when pedestrian lighting is used to supplement street lighting to support high nighttime pedestrian activity, the pedestrian lighting may be turned off when pedestrian activity decreases late at night.

Light Levels and Uniformity

Light level and uniformity ratio requirements for roadway lighting are listed in Figure 6.3 and are based upon the American National Standard Practice for Roadway Lighting (RP-8) by the Illuminating Engineering Society of North America (IESNA), the adopted city lighting standard. Roadway classifications used in RP-8 are based on traffic volume.

Light levels will decrease as lamps get old and lighting fixtures get dirty. Light levels should be adequate even when light levels decrease over time. Light level calculations should be performed using the light loss factor stipulated by the City to account for these anticipated decreases.

Lighting fixture spacing should be based on light level and uniformity requirements in RP-8. A relatively evenly spaced layout within a block and consistent spacing between trees and lighting fixtures are desirable to provide consistent light levels and good uniformity.

Pedestrian lighting should be provided on high pedestrian volume corridors or where a special design treatment is desired to supplement roadway lighting. Pedestrian lighting should be consistent throughout a block, minimize variance between bright and dark areas, and should be highlighted at pedestrian crossings.

The City does not have a current standard for pedestrian light levels. As part of a future Street Lighting Master Plan, the City should create a standard for pedestrian lighting.

Existing Light Fixtures – Inventory

Existing lighting fixture locations should be used wherever possible, but the lighting layout should meet light level and uniformity criteria and other considerations listed in this document. When selecting a fixture, if the City already has approved and/or is using the same style of fixture, consider using the fixture the City has already approved. The quantity of fixture types in the City should be minimized and consolidated to as few as practical while maintaining the aesthetic and technical requirements set forth in this document.

The City's approved palette of light fixtures should be evaluated and updated through a subsequent street lighting master plan.

Maintenance

Manufacturer Selection

The lamp, parts and accessories for lighting fixture maintenance should be easily accessible in the fixture and obtainable in the market place. When specifying a lighting fixture, the ease of maintaining and replacing the ballast, lamp, lens and other major parts should be evaluated and fixtures that are easy to maintain should be part of the selection criteria. A reasonable parts inventory should be maintained by the City for commonly replaced parts such as lamps, ballasts and touch up paint. It should also be easy to obtain parts through a local distributor.

Only well established lighting, pole and lamp manufacturers should be specified. If a lighting manufacturer used by the City goes out of business, another manufacturer with a similar style of fixture should be selected if a fixture or pole has to be replaced in the future. If custom designed lighting fixtures are proposed for a neighborhood, the City should retain ownership of the fixture design so it can be replicated by another manufacturer if the original manufacturer can no longer produce it.

Tree Pruning

Tree pruning is important to maintain uniform light levels on the street. The clearance between tree foliage and the lighting fixture is dependant upon the tree type and lighting fixture type and height. See Section 6.1: Urban Forest.

Figure 6.3

LIGHT LEVELS AND UNIFORMITY

STREETSCAPE TYPE	Horizontal light level range ^{1,2} at ground Minimum maintained average ³	Uniformity ratio range ^{1,2} Average/Minimum
Downtown Commercial	Defer to Downtown Streetscape Plan	Defer to Downtown Streetscape Plan
Downtown Residential, Neighborhood Commercial (IESNA Roadway classifications: Major/Collector/Local)	0.5 to 1.7	3 to 6
Commercial Thoroughway (IESNA Roadway classifications: Major/Collector)	0.6 to 1.7	3 to 6
Neighborhood Residential (IESNA Roadway classifications: Collector/Local)	0.3 to 1.2	4 to 6
Residential Thoroughway (IESNA Roadway classifications: Major/Collector/Expressway)	0.4 to 1.2	3 to 4
Industrial Multi-way Boulevard ⁴ (IESNA Roadway classifications: Major/Collector/Local/Expressway)	0.3 to 1.7	3 to 6
Industrial Mixed-Use Parkway Park Edge (IESNA Roadway classifications: Major/Collector/Local)	0.3 to 1.7	3 to 6
Processional	Defer to potential subsequent design plan	Defer to potential subsequent design plan
Alleys (IESNA Roadway classifications: Alley)	0.3 to 0.5	4 to 6
Paseos (IESNA classification: Pedestrian walkway)	0.3 to 1	4 to 6

¹ Requirements in RP-8 are periodically revised and updated. Latest edition should be used for determining the light level and uniformity ratio requirements.

² A range of light levels are listed. The exact minimum maintained average light level depends upon traffic and pedestrian volume and pavement classification (related to pavement reflection of light) for any given street. These variables must be verified for each street to determine exact minimum maintained average value. Verify technical classifications with the City for both roadway and pedestrian paths for individual streets.

³ Minimum maintained average is the lowest accepted value of an average light level calculated with a light loss factor.

⁴ A Multi-way Boulevard may have different roadway classifications for the thoroughway portion and the local access lanes of the boulevard. Local access lane lighting requirements will vary with adjacent land use context. Verify technical classification with the City for each street.



*Special paving
can be used to
both define the
edges of spaces
and to visually
enhance entire
spaces.*

6.4 PAVING

Paving can consist of traditional paving materials such as concrete or asphalt or non-traditional materials that should be used as accents or in key locations. Typical asphalt and concrete paving are proven materials that meet the standard needs of vehicle and pedestrian circulation; however special paving treatments can improve public spaces in a city, give circulation areas a stronger sense of place and enhance the hierarchy of public spaces. Special paving treatments include a range of options, such as natural stone pavers, unit concrete pavers, bricks, wood, textured and colored concrete, stamped asphalt, and concrete with exposed or special aggregate or other finish treatments.

Special paving can be used to both define the edges of spaces and to visually enhance entire spaces. Special paving is key to com-

municating pedestrian primacy such as within heavily traveled crosswalks or smaller shared streets and adds visual variety to the streetscape.

Special Paving can be a functional stormwater amenity as well as an aesthetic enhancement. Permeable paving is another form of special paving that can have many different looks and provides stormwater benefits (See Permeable Paving in Section 6.2). Permeable unit concrete pavers can provide both function and aesthetic appeal and should be used where an enhanced design treatment is desired. Permeable asphalt and concrete change the surface function but do not greatly enhance the overall aesthetics of the site.



➔ Placement

Sidewalks should use standard scored concrete paving at a minimum. In addition, special paving may be included as a component of any street type. It is most appropriate on downtown streets, commercial Streets, ceremonial streets, and small streets. Specifically, special paving should be considered in the following locations:

- transit stop areas, including transit curb extensions and medians
- pedestrian crossings, especially at important civic locations, neighborhood commercial areas, and other special districts
- midblock and raised pedestrian crossings
- pedestrian refuge areas within medians
- shared streets, as an edging treatment to tree basins and planting areas, and across the entire street where a full shared street treatment is considered
- local access lanes where a shared street treatment or raised crossings are applied
- transit malls, pedestrian malls, promenades, waterfront areas, and other areas where temporary closures or potential future permanent closure for pedestrian use is considered
- flexible space in parking lanes

- as an edging treatment around and for paths within mid-block pocket parks
- curb extensions
- in the furnishings zone
- along urban walkways and pathways
- diveways
- gateways and other special places

🕒 Guidelines

Paving Type

Standard Paving: Standard sidewalks should use concrete scored in 3' x 3' squares.

Downtown sidewalks should use concrete mix to the specifications of the Downtown Streetscape Plan.

Special Paving: Pavers consist of sand set pavers, mortar set pavers, and permeable or porous pavers over clean drain aggregate. Special pavers include natural stone pavers, unit concrete pavers, unit concrete permeable pavers, textured and colored concrete, stamped asphalt, concrete with exposed or special aggregate or other finish treatments. Special aggregates, colors, and textures may also be considered.

PERMEABLE PAVING

A number of permeable paving materials not only create attractive streetscapes but can serve an important ecological role in improving the sustainability of streets. See Section 6.2: Stormwater, for detail.



Left: Special paving as a field treatment.

Right: Special paving used to delineate the edge and frontage zones separate from the furnishings and thruway zones.



Patterns and designs within fields of a material can add unique and interesting detail



When non-customary materials are used, they should extend for at least a complete block for design consistency and maintenance efficiencies. Similarly, non-customary scoring should extend for at least one block.. Exceptions can be made where special paving is being used to highlight transit stops, parks, plazas, or other site-specific features.

Accessibility

Special attention should be paid to accessibility and comfort considerations of paving materials in selecting appropriate locations for different paving types. Generally:

- Paving materials should not pose tripping hazards or cause excessive vibration for wheelchairs
- All paving systems should be designed, installed, and maintained to be smooth and level. Surfaces should not be interrupted by steps or abrupt changes in level of more than 1/4 inch.
- Unit pavers must have gaps of no more than 1/4 inch
- Saw cut joints in poured concrete are preferable to troweled joints
- Surfaces with a slope of less than 6 percent gradient should be at least as slip-resistant as what could be described as a medium salted finish. Surfaces with a slope of 6 percent gradient or more must be slip-resistant.
- Surface cross slopes should not exceed 1/4 inch per foot except where, due to topography, it creates an unreasonable hardship, in which case the cross slope shall be increased to a maximum of 1/2 inch per foot

Refer to the standards and guidelines below and those of the ADA and Title 24 for more information. See DPW standard engineering plans for sidewalks for construction details.

Specific guidance for design of curb ramps is presented in Section 4.1: Crosswalks. Curb ramps should be treated in either smooth solid concrete or paving treatment to match adjacent paving.

Installation

Special paving materials should follow these guidelines:

- Surface materials with low maintenance requirements and high durability, slip-resistance, and compressive strength should be selected
- The engineer or designer should retain a certified geotechnical engineer and a geotechnical investigation report should be referenced for soil type and loading capabilities
- Soil type and settlement potential should be understood when choosing a paving surface material and sub-base thickness
- A proper sub-base is as important as the surface material. Use of a recycled sub-base is recommended. Suppliers of recycled materials should be asked to provide material testing results for loading equal to Caltrans classification standards.
- Expected loading should be known, e.g. truck, emergency vehicles, automobile, pedestrian. The paver and sub-base depth should be designed for the heaviest expected loading per City standards. A concrete slab with mortar pavers is recommended in high traffic areas with heavy loading for long-term durability.
- Settlement can be an issue in areas of high clay content or over “Bay Mud”. An enhanced sub-base or concrete slab base is typically required per geotechnical recommendations.
- Manufacturer recommendations for maximum slopes and minimum recommended sub-base depth and material should be followed
- Percolation tests or soil science reports should be conducted if permeable or porous pavers are used. Where infiltration is not feasible, an underdrain can be used.

Layout

Special paving can be implemented as a field treatment, consistent across the entire sidewalk, plaza, or shared space, or can define areas within the streetscape. Where implemented as a field treatment, it should be organized in regular or organized artistic patterns.

Special Paving at Specific Locations

Special paving should be considered for installation in the following locations subject to the guidance elaborated in the related sections of this document. Recommendations are summarized below.

Planting and Furnishings Zone (Section 4.2): Special paving in the planting and furnishings zone can visually separate this space from the rest of the environment, highlighting its function as an area to sit or step out of pedestrian flow. Permeable paving, such as pavers set on a clean aggregate gravel subbase, should be used where possible to allow stormwater infiltration, water, and oxygen to tree roots below.

Pedestrian Crossings (5.1): Special paving treatments communicate to individual users that the crosswalk is part of pedestrian space, not an encroachment by pedestrians into the roadway. Paving, texture, and color treatments are especially important in places where it is important to make pedestrians more comfortable crossing.

The application of special paving in crosswalks should consider “wear and tear” that will be caused by vehicles crossing the paving, and requires additional capital and maintenance funding. The paving should be designed and installed to maintain the desired visual and textural appearance. Special paving is not a substitute for standard or high-visibility retro-reflective crosswalk markings. Standard 12” transverse lines should still be used outside a decorative crosswalk treatment to establish a marked crosswalk.

Curb Extensions (5.3): Where curb extensions are added, they may be designed as useable pedestrian spaces. Special paving can reinforce this intention by visually separating curb extensions from the adjacent sidewalk, and suggesting that these spaces are meant for a separate purpose: sitting and relaxing as opposed to just walking.

Pedestrian Refuge Areas in Medians (5.4): Special paving should be considered at pedestrian refuges. The pedestrian path through the median and adjacent areas may include special paving.

Transit Stops (5.5): Special paving treatments should be considered at transit stop locations to define the waiting zone and to clarify connections to transit. Curb extensions and transit boarding islands should be paved with finer-grained paving treatments ranging from unit pavers to special scoring and color in concrete. At transit stop locations where there is no curb extension, distinctive sidewalk treatments in the furnishing zone should be considered.

The sidewalk throughway adjacent to transit stops should be treated similarly to the surrounding sidewalk area to distinguish the transit stop area from the sidewalk throughway.

Flexible Space in Parking Lanes (5.6): Special paving should be used to differentiate the “flex” space from the throughway of both the adjacent vehicular travel lane and pedestrian sidewalk adjacent to the flex space. Special paving should be used to designate the outdoor rooms meant for people to sit and relax.

Pocket Parks (5.8): Special paving should be considered as an edging treatment around sidewalk pocket parks and planting areas. Travel lanes adjacent to these areas can use special paving to indicate a shared space where pedestrians may cross the street from the sidewalk to the open space. Within such spaces, permeable pavers and other alternative permeable surfaces such as decomposed granite are highly recommended for paths, edging, and other hardscape.

Shared Streets (5.8): On shared streets, special paving is integral to communicating that the entire right-of-way is a space to be shared between pedestrians and vehicles. Paving patterns and layout should be used to convey the location of spaces within the right of way, defining the edges for parking, playing, sitting, and highlighting the edges of planting areas.

Boulevard Treatments (5.8): Special paving can be used to communicate the function of the local access lane in boulevard treatments. The change in material identifies a space intended for local circulation and that differs from the through lanes in the center of a multiway boulevard. Where a shared street treatment



▲ Special paving can define the transit waiting and circulation area for pedestrians, even where a shelter is not present.

▼ Special paving at crossings and on pedestrian refuges makes crossing more comfortable for pedestrians.





or raised crossings are applied to enhance the sense of the local access as neighborhood space, special paving on the entire lane should be used enhance this function.

Transit Malls, Pedestrian Malls, and other closures (5.8): Where a whole right-of-way is converted to pedestrian space or special mixed transit and pedestrian space, or where frequent temporary closure for pedestrian use is considered, special paving should be used to enhance the space for pedestrians. Special paving should be used to define and highlight spaces within the public right-of-way, breaking the space down into a more pedestrian scale.

Driveways (6.6): Driveways can use interlocking pavers, pervious concrete, and other similar materials to add visual variety to the streetscape, and allow infiltration where appropriate.

Other Considerations

Responsible Material Choices

Many paving surfaces, sealants, coatings, traffic markings, and other products are composed of materials that are harmful to the natural environment. The type of material selected should consider the level of volatile organic compounds (VOCs) and specify zero- to low- VOC agents. PAH free sealants and/or asphalt bases should be considered.

Many paving surfaces are composed of natural materials derived from highly impactful quarrying and processing methods that are damaging to the natural environment. The City should encourage the use of recycled or reclaimed materials. Granite curbs removed during retrofit should be reused, either on-site or on other streetscape projects.



Permeable pavers add attractive detail, and allow stormwater to infiltrate.



▲ Unique paving treatments convey a sense of scale, detail and orientation that is welcoming to pedestrians.

▼ Paving treatments can be used to accent the sidewalk by outlining trees or whole sidewalk zones.



Site furnishings announce that pedestrians are welcome and that the street is a comfortable place to be. These amenities provide a functional service to the pedestrian and provide visual detail that makes a place comfortable and interesting.

6.5 SITE FURNISHINGS

Site furnishings provide important amenities for pedestrians by adding functionality and vitality to the pedestrian realm. They include: benches and seating, bicycle racks, bollards, flower-stands, kiosks and gateway monuments, newsracks, parking meters, public art, sidewalk restrooms, trash receptacles, wayfinding signage, and other elements not specifically discussed here. Transit shelters are discussed in Section 5.5.

Site furnishings announce that pedestrians are welcome and that the street is a comfortable place to be. These amenities provide a

functional service to the pedestrian and provide visual detail that makes a place comfortable and interesting.

Pedestrian amenities should be considered a requisite public expenditure just as other necessary elements of the street, such as traffic signals and signage. Improved street vitality has marked impacts on public safety and comfort, health of local businesses, local real estate value, and transportation habits¹.

¹ Case Study No. 20: *The Effects of Environmental Design on the Amount and Type of Bicycling and Walking*, National Bicycling and Walking Study, US Federal Highway Administration.



➔ Placement

Site furnishings should be prioritized on:

- Streets with a large amount of pedestrian activity
- Streets where pedestrians may linger and enjoy the public realm, such as downtown, commercial, mixed-use, or special streets
- Streets with a recreational role such as Parkways, Park Edge Streets, and Boulevards
- Other streets should include site furnishings at corners and busier blocks, or where warranted by adjacent land use and pedestrian activity.
- On residential streets, alleys and on curb extensions on any street, clusters of pedestrian amenities can create attractive and inviting public spaces where neighborhood residents or patrons of local businesses can sit and rest, play, eat, or enjoy people watching.

Specific location guidelines for each element are detailed by element on the following pages.

🔄 Guidelines

General

General location guidance provided in Section 4.2: Overall Streetscape Guidelines should be consulted when determining a strategy for laying out a whole street, block, corridor, or district. Specific guidance for furnishing layout at transit stops is provided in Section 5.5.

Site furnishings should be considered secondary to street trees and lighting. Street tree and lighting placement should define the major rhythm of design elements along the street, and site furnishings should be placed in relation to trees and lighting, after the best locations for these elements have already been located.

In downtown, site furnishings should follow the Downtown Streetscape Plan guidelines.

In addition to the specific guidelines for each element, street furniture should conform to these minimum requirements for sidewalk element placements, unless otherwise noted. Elements should be placed not less than:

- Eighteen inches (18”) from the outside edge of the curb
- Two feet (2’) from any driveway or wheelchair ramp and four feet (4’) at the landings of the ramp
- Five feet (5’) from any fire hydrant and two feet (2’) from a stand pipe
- Four feet (4’) from any MUNI transit shelter

Placement of site furnishings should consider car overhangs and door swing. When placed near the curb, furnishings should be located at the ends of the on-street parking stalls rather than at the center wherever possible.

Site furnishings should be clustered at transit stops. See Section 5.5

Site furnishings may also be placed within curb extensions where sidewalk widths are extended into the parking lane. Dining areas for adjacent restaurants can be located on long curb extensions, in flexible parking areas, or in the furnishings zone. See Section 5.3: Curb Extensions and Section 5.6: Parking Lane Treatments.

San Francisco should create a unified, replicable palette of Site furnishings that can be customized to reflect the local character of the surrounding neighborhood to contribute to a sense of community identity.



CHAPTER 6: SITE FURNISHINGS

The following site furnishings are discussed in this section:

- Benches and seating
- Bicycle racks
- Bollards
- Flowerstands
- Kiosks and gateway monuments
- Newsracks
- Parking meters
- Public art
- Sidewalk restrooms
- Traffic and parking signs
- Trash receptacles
- Wayfinding signage



DESIGN CONSIDERATIONS FOR ACCESSIBLE FURNISHINGS

Technical provisions for accessible features appropriate to pedestrian facilities may be found in the following sections of ADAAG:

- 4.4 Protruding Objects
- 4.15 Drinking Fountains
- 4.22 Toilet Facilities
- 4.27 Controls and Operating Mechanisms
- 4.29 Detectable Warnings
- 4.30 Signage
- 4.31 Public Pay Telephones
- 4.32 Fixed or Built-in Seating and Tables
- 4.34 Automated Teller Machines

The US Access Board web site www.Access-Board.gov contains proposed and new accessibility guidelines for the Americans with Disabilities Act, the Public Right of Way and for outdoor recreation that may be appropriate best practices for pedestrian facilities.



Seating can be oriented in social layouts or in individual locations to allow people to converse or to sit alone.

ADA Requirements

All site furnishings must be accessible per ADA guidelines and City regulations, including the following:

- Site furnishings must maintain the minimum 4 foot ADA required clear accessible route, and should leave the minimum through widths described in Section 4.2.
- Objects mounted on walls or posts with leading edges above the standard sweep of canes (27 inches) and below the standard head room clearance (80 inches) should be limited to a 4 inch maximum protrusion.
- No sidewalk element may interfere with pedestrian access to the entrance of any building; this includes the path of travel and disabled access requirements of ADA and Title 24. This includes all paths of travel or exiting. No site furnishings may be located below a fire escape or over a utility valve or utility box.
- Wherever possible, site furnishings should be of a contrasting color to the sidewalk so as to aid pedestrians with visual impairments.
- Site furnishings should leave a minimum 8' of clearance adjacent to disabled parking and passenger loading zones.

Benches and Seating

Public seating warrants particular attention because it creates a comfortable, useable, and active public environment where people can rest, socialize, read, or simply people-watch. It is a simple gesture that can go far to create an important sense of place. Seating creates places where people, able to see others and be seen, feel safe. This ability to entice people to linger is the hallmark of great and successful public space.

Location of Benches and Seating

Seating arrangements should be located and configured according to the following guidelines:

- Seating should be located under trees where possible to provide shade and comfort and to integrate multiple elements

- Informal seating (low walls, etc.) can also be incorporated into other elements in the site furnishings zone, such as at planter edges. Where space allows, benches can be built into planters.
- Where seating is oriented parallel to the curb, it should face toward buildings when located in the furnishings zone, or away from buildings when located in the frontage zone
- Where sidewalk width permits, seating in the furnishing and planting zone should be perpendicular to the curb
- Seating should be provided on curb extensions in an organization that is grouped to create social spaces
- Seating incorporated into building form, such as seat-walls, is an alternative to free-standing benches, and should be encouraged as a strategy to activate the front of larger developments as part of the streetscape
- Seating should be designed to encourage sitting and to discourage lying down

Given the visual character and amenities in San Francisco and the areas around it, there are many scenic locations where varying from some of these guidelines may be appropriate in order to take full advantage of a street's setting. For example, seating may be oriented towards a view, rather than towards a street when doing so would provide an additional amenity.

Design of Benches and Seating

Seating and other amenities should be made of durable, high-quality materials. Design of seating should complement and visually reinforce design of other streetscape elements.

Seating should be designed as an integrated part of other streetscape elements where possible, including:

- Integrated seat walls in pedestrian refuges
- Seat walls and benches around trees and landscaping
- Part of public art and gateway monuments

- Other elements where integration improves utility of the element to pedestrians without compromising its primary function

50% of public benches in a group, or at least 1 bench, must be ADA accessible. See Section 4.32 of ADAAG.

Temporary or moveable seating may also be used, particularly in locations where there is active street management by adjacent businesses, a merchant's association, or the like. Temporary seating allows people to orient seats to meet specific social and microclimate needs. Moveable seating and tables for sidewalk dining must comply with DPW permit requirements.

Unfortunately, in some cases fear of loiterers has resulted in seating that is so uncomfortable that no one would want to use it, or the removal of pre-existing seating altogether. The City should maintain a strong presumption against removing seating in the public right-of-way, and should include seating as a standard pedestrian furnishing in new streetscape design projects to encourage usability and activation of the public realm.

Bicycle Racks

Bicycle racks are an important element of the streetscape, both as an aesthetic aspect of the streetscape and as a functional element for those who travel by bike. According to the 2000 US Census, San Francisco has the highest percentage of residents who commute to work by bicycle among cities with a population of 500,000 or more.

Bicycle racks are also opportunities for distinctive design and public art elements. Where part of a special maintenance or public art program, uniquely designed, yet functional bicycle racks are encouraged.

Location of Bicycle Racks

Bicycle racks should conform to SFMTA's bicycle rack placement criteria.

Bicycle racks should be located according to the following guidelines:

- Placement and spacing of bicycle racks should consider dimensions when occupied
- Bicycle rack placement should be frequent in active commercial districts.
- Racks should be provided near major destinations such as schools, libraries, transit stops, major shopping and service destinations, and other locations with high pedestrian traffic
- Where parking meter consolidation programs (as described later in this section) are implemented, bike racks should be provided to replace meter poles, or meter poles should be retrofitted with rings to allow bike parking.
- Racks should be located in either the furnishings zone or on curb extensions where possible. Racks should



BEST PRACTICE: MINT PLAZA

SAN FRANCISCO, CALIFORNIA

San Francisco's newest outdoor plaza is located on Mint Street, formerly an alley that provided access to the US Mint but was converted to a pedestrian plaza. Mint Plaza is a finely detailed pedestrian space, with high quality paving stones, attractive trellises and landscaping, and small businesses including new cafes. Mint Plaza was designed with detectable and discernable edges following the original sidewalks to provide a clear path of travel for people with visual impairments.

The plaza has a variety of landscape features with built in seat walls as well as a number of tables and chairs that can be moved to allow people to rearrange the furnishings to fit their needs or comfort, adding chairs for bigger groups or moving into the sun or shade to be more comfortable. This high level of design detail and the freedom to set up a table anywhere on the plaza allows pedestrians to feel comfortable using this urban space.



Seating should be integrated with other elements, such as tree guards, where possible.



Bike racks should be located near other streetscape elements, such as trees and planters, to cluster amenities

Bicycle racks should be located at popular destinations, such as this one at the San Francisco Main Library.



Bike racks can be combined with other streetscape elements such as tree guards..



not be placed at blue zones, or at transit stops except for the last 5 feet.

- Bike racks placed in the sidewalk furnishings and planting zone should be parallel to the curb so that bikes parked at them do not project into the sidewalk thoroughway or edge zone. On curb extensions and sidewalks that are wide enough to accommodate the full length of a bike, bike racks should be placed perpendicular to the curb at either edge of a tree basin, a minimum of 2 feet from the edge to allow a person to easily pull their bike in and out.
- A rack should not be located closer to the curb than two feet. Three feet from the curb is ideal, although in certain circumstances, the distance may be greater.
- Bicycle racks should not be located directly in front of a store/building entrance or exit or in a driveway
- There must be at least 3 feet of clearance between bicycles parked at racks and any other street furniture, with the exception of other bike racks, which should be placed a minimum of every 3 feet on center.
- Street utility vaults, such as PG&E, must have a 12 inch clearance from a bicycle parked at a rack.

On-street bike parking: Where sufficient demand exists or where sidewalk space is constrained, replacing an on-street vehicle parking space with bicycle parking should be considered. (See Section 5.6).

Design of Bicycle Racks

Design and selection of bicycle racks should consider the following guidelines:

- A bike rack should be sturdily attached to the ground to prevent theft
- Galvanized or stainless steel materials that are not powder-coated are more secure and are easier to maintain; where there is a specialized streetscape palette with particular design

scheme, bicycle racks should be considered that match other site furnishings

- All elements of a bike rack should have a minimum 2 inch diameter (or 2 inch square tube)
- Racks should offer a minimum of 2 points of support for bikes unless the rack can support a bike in two places, such as a post and ring configuration

The inverted “U” rail rack is the preferred rack for normal sidewalk installation.

New designs that integrate decorative tree guards with bicycle parking should be considered for their efficiency in providing more benefit to the streetscape and maintaining more open space on the sidewalk. Artistic bike racks or racks integrated with other elements should also follow the above recommendations.

New development should be encouraged or required to install on-street bike racks as part of development approvals where appropriate.



The inverted “U” rail rack is the preferred rack for most sidewalk installations.

Bike sharing: Bike sharing, if implemented in San Francisco, will require a substantial number of new bicycle racks throughout the City. In such circumstances, conversion of on-street parking to bicycle parking may be necessary (See Section 5.6).

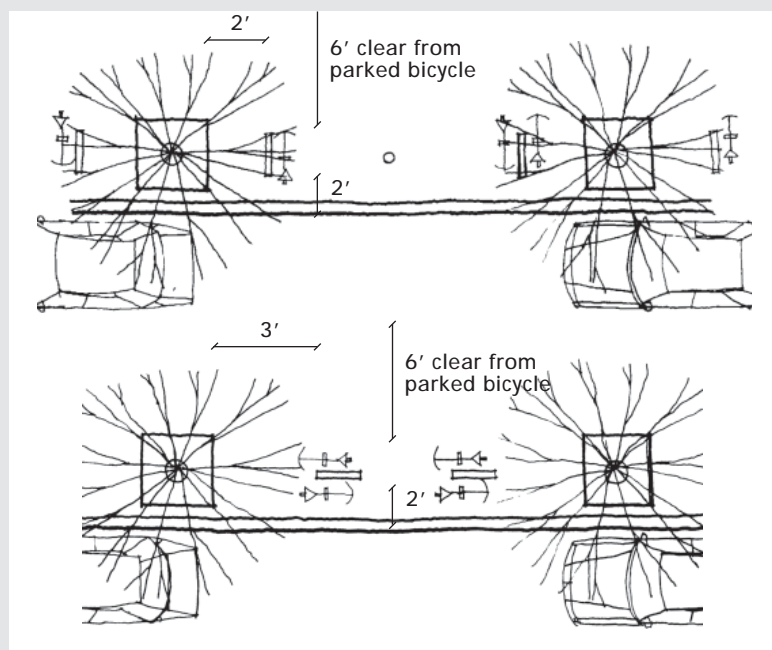
Bollards

Bollards are primarily a safety element to separate pedestrians or streetscape elements from vehicles. Attractively designed bollards add color and interest to streetscapes, help define pedestrian spaces, and provide a spot to lean on or rest at.

Location of Bollards

Bollards should be located according to the following guidelines:

- Bollards should be used at sidewalk locations where vehicles attempting to park are damaging sidewalk structures, trees or plantings (e.g.



Appropriate bike rack placement Top: Wide sidewalks (generally > 12') Bottom: Narrow sidewalks (generally < 12')

in the parking lane), furnishings, or adjacent private property, especially on alleyways

- Bollards should be considered for installation on median islands, curb extensions (but not on the boarding side of transit loading islands or extensions), and mid block curb extensions, where there is a risk of danger to pedestrians due to proximity to travel lanes.
- Attractive bollards can also be used in special locations, including pedestrian-oriented spaces such as pedestrian pathways, to designate unique spaces. Lighted bollards can create a special pedestrian environment, and may be particularly useful to provide additional pedestrian lighting in median refuges.
- Removable bollards should be placed at entrances to streets that are closed to vehicles for pedestrian use, to alert drivers to the changed nature of the street. Similarly, removable bollards can define the outside edge of flexible parking spaces (see Section 5.6) where the space has been converted to pedestrian use.
- Bollards should be placed 18-inches from the back of the curb. If there is no parking in the bollard placement area, the bollard may be installed immediately adjacent to the back of the curb.
- All bollard installations should leave a minimum of through space per Section 4.2.
- Standard bollard spacing is approximately 10 feet on center, but may need to be reduced where there is a need to block vehicular traffic. Spacing should vary to sync with the rhythm of lighting fixtures, trees and landscaping, or other elements in the streetscape.

Design of Bollards

Bollards typically range in size from 4 to 10 inches in diameter, however decorative bollards can be larger and vary in form.

Bollards should have articulated sides and tops to provide design detail. Bollards should be painted in colors other than gray to be easily seen by the visually impaired, in colors that complement other streetscape elements. Bollards should be designed within a 'family' of streetscape elements.

In circumstances where bollards are used to temporarily close a street or flex parking space, removable bollards should be designed with long sturdy pipe projections from the bottom that fit into a hole in the ground. Removable bollards should be designed and installed such that, when in place, they are sturdy and look permanent. Electronic retractable bollards that can be lowered into the roadway to selectively allow vehicles to pass, should be considered where streets are closed to allow emergency vehicle access.

Flowerstands

Location of Flower Stands

Flowerstands should not exceed 3 feet in width and 10 feet in length. The total flowerstand area (including displays) should not exceed 5 feet in width and 20 feet in length.

A minimum of 6 feet clear pedestrian passage between the edge of the display area and other objects should be maintained on the sidewalk at all times in front of flower stands.

For flowerstands outside of the public right-of-way, only temporary displays should be located in the public sidewalk area. These displays should not exceed 2 feet in width.

Kiosks and Gateway Monuments

Gateway monuments are typically larger structures in the pedestrian realm that can function as a major visual element, establishing a gateway to a special area or visually linking a corridor or commercial district. Kiosks are public elements that are sources of information, and may include maps, bulletin boards, or other useful information. Kiosks and gateway elements can be combined into a single element, providing attractive and useful streetscape elements.

Location of Kiosks and Gateway Monuments

Kiosks and gateway monuments should be located according to the following guidelines:

- They should not be located on sidewalks less than 12 feet wide or on any sidewalk on which their placement would cause pedestrian flow to be unreasonably constricted



▲ Bollards protect pedestrians from passing traffic and can be an attractive streetscape accent.

▼ Bollards come in a variety of sizes and designs.



6.5 SITE FURNISHINGS



Gateway elements can define the entrance to and identity of a neighborhood or retail district.



Pedestal-mounted newsrack

- They should be located in the furnishings zone
- Public service kiosks (those primarily providing information) should be separated not less than 150 feet per block face with a maximum of two kiosks per block face. When more than one kiosk is installed on a street, all kiosks should be placed on the same axial line at regular intervals.
- Kiosks and gateway monuments should be placed on corner and mid-block curb extensions wherever possible
- Wherever possible, public service kiosks should be placed at red curb zones that are not bus stops
- Kiosks and gateway monuments should not be placed within transit stops
- No more than two informational kiosks should be placed at any intersection
- Gateway monuments should typically be placed in pairs on opposite sides of a street to denote entrance into a commercial district or neighborhood. In circumstances where context or design dictates, a single gateway element can be placed.
- Kiosks and gateway monuments should be placed such that they do not block scenic views

Design of Kiosks and Gateway Monuments

Kiosks should communicate information by including bulletin boards for community posting, enclosed cases for display of city information, or permanent lettering. Where a kiosk serves as a gateway element it should include a neighborhood, commercial district, street, or park name or other information.

Sidewalk kiosk design must conform to the guidelines outlined in Department of Public Works order number 163,368.

When more than one kiosk is installed on a street, all kiosks should be of the same, or complementary, design and scale.

Gateway monuments and kiosks can be artistic and expressive. They should reflect an area's special character through their design and can be integrated with public art.

Newsracks

In addition to the following guidelines, newsracks are subject to all of the guidelines in the City and County of San Francisco Public Works Code, Part II, Article X, Section 5.4 and all applicable Department of Public Works orders.

Location of Newsracks

Newsracks should be located according to the following guidelines:

- The ideal location for a newsrack is next to a red curb that is not marked for a bus stop
- Only 1 six-unit pedmount newsrack may be placed behind the curb of any passenger (white) loading zone
- Newsracks should be permanently affixed to the sidewalk
- Newsracks should be placed in building setbacks, instead of the furnishings zone wherever possible, with the property owner's approval. Where newsracks are located in the furnishings zone, placement should leave a minimum of six feet clear pedestrian passage between the newsrack and the property line. This clear width should be 8 feet in downtown areas per the Downtown Streetscape Plan.
- Newsracks should be placed no closer than 2 feet from adjacent street signs
- Newsracks should be placed a minimum of 4 feet from bike racks
- No newsrack should be placed within 6 feet of the curb for the length of any bus zone
- A maximum of five free-standing newsracks may be placed in a continuous row. No more than two pedmount newsracks may be placed within 5 feet of each other except if the sidewalk is 25 feet wide or greater, in which case up to 3 pedmounts can be placed.

Design of newsracks

Where possible, newsracks should be consolidated into a single integral cabinet. The cabinet should have an attractive, clean, and simple design that complements the design and color of other street furniture.

Parking Meters

Parking meters are commonly found on downtown and commercial streets. Parking meters can be either traditional single-space meters or consolidated multi-space meters.

Many cities are moving toward multi-space meters as a parking management tool. Multi-space meters also have an important impact on streetscape aesthetics and, where implemented, should consider the recommendations of this section. Consolidating parking meters can reduce the number of poles in the sidewalk by combining multiple parking meters on a block face, resulting in a more orderly visual environment. This may allow for the installation of additional trees or site furnishings.

Placement

Single space meters should be placed in the edge zone. They should be placed at the front end of individual parking stalls.

Multi-space meters may be placed in the edge zone or furnishings zone. Consolidated parking meters typically require installation of an entire new unit, and cannot be affixed to existing meter poles. Typically, multi-space meters should be placed every 8 to 10 parking spaces, roughly 150 to 200 feet apart.

Signage should clearly direct patrons to the multi-space parking meter. Signage directing patrons to multi-space meters should be placed every 100 feet (4 to 5 parking spaces). Information should be located on pre-existing traffic or parking sign poles wherever possible.

Design and consolidation

From a streetscape design standpoint, the City should encourage the conversion of single space meters to multi-space meters to reduce the number of elements in the streetscape. However, the decision to convert should be made on the basis of parking management considerations.

When converting single-space meters to multi-space meters, old parking meters and poles should be removed. When meter poles are removed, consideration should be given to adding bicycle racks along the street to replace bicycle parking lost from removal of meter poles.

Multi-space meters should be selected to minimize their footprint on the sidewalk.

Some payment mechanisms require striping, and in some cases numbering, of individual spaces on the roadway while others allow cars to freely fill in the entire block. Where roadway striping and/or numbering is required it should be minimal and not visually distracting or unnecessarily large.

Technical provisions for controls and operating mechanisms may be found in section 4.27 of ADA Accessibility Guidelines.

Public Art

Public art is an important aspect of major streetscape design projects. On a large scale, public art has the ability to unify a district with a theme, and, at a pedestrian scale, it can provide visual interest for passersby.

Many of the improvements suggested in these guidelines will be constructed using public money, and will include a public art budget.

Public art is not a replacement for good urban design. Public art can add interest and delight to a pedestrian's experience,. However, streets and all streetscape elements should also be designed to promote pedestrian and public space use.

Location of public art

Public art should be located on streets and in public spaces with high volumes of pedestrian traffic to denote a special place or to draw people's interest to the space they are in. Public art can also be located in areas where few people pass to create unique and special places for people to enjoy. Downtown streets and boulevards are particularly appropriate for the former, while stairways



Multi-space parking meters are used in many cities across the country



BEST PRACTICE: GROWING VINE STREET SEATTLE, WASHINGTON

This proposal for Seattle's Vine Street seeks to integrate public art and ecological considerations. The project's main objectives are to reveal and re-introduce into the urban setting the natural hydrologic cycle; create a neighborhood green space; and provide opportunities for functional public art.

The project's central concept is to create a "runnel" (a narrow water channel) lined with native greenery along the entire eight-block length of the street. Stormwater would be collected through large roof cisterns and would be discharged into the runnel for treatment and filtration. While the proposal is still mainly on the drawing board, several public art elements are already in place. These include "Green Downspouts," a rain gutter with plants growing out of upturned downspouts.

and pathways provide unique spaces, often very distinct to San Francisco, that fulfill the latter.

Public art, and Arts Commission approval, is required on projects that create new structures in the right-of-way per Section 3.19 of the Administrative Code (the Public Art Ordinance).

Design of public art

Public art will be unique to each situation; however, the following guidelines apply:

- Public art should be located so as to be a pedestrian amenity. A piece can act as a focal point in a park or plaza or present a "surprise" along a pedestrian path that rewards the passerby with visual interest.
- Consideration should be given to incorporating art into otherwise standard street elements such as light poles, benches, trash receptacles, and utility boxes.
- San Francisco has a unique cultural history of mural artwork in the Mission and throughout the city. Painting of murals should be encouraged on public utility and highway structures that may line some streets with large otherwise blank, or graffiti filled, concrete walls.
- Art can provide information, such as including maps and signage, or educational in regards to the history and culture of San Francisco's neighborhoods and citizens. All installations do not need an educational mission, however—art can be playful.
- Public Art should be accessible to persons with disabilities and must not be placed in a way that compromises the clear path of travel. Art pieces may require detectable warning strips around the base of the art piece.

Public art should be considered during the planning and design phase of development to more closely integrate art with other streetscape elements.

Sidewalk Restrooms

Location of Sidewalk Restrooms

Sidewalk restrooms should be located according to the following guidelines:

- Sidewalk restrooms should be located in the furnishings zone, a minimum of two feet from the outside edge of the curb.
- Sidewalk restrooms should be placed a minimum of forty inches from existing sidewalk elements such as street trees, benches, and lighting poles.
- Sidewalk restrooms are not permitted on sidewalk less than 14 feet wide, or on any sidewalk on which their placements would cause pedestrian circulation to become constrained, a clear width of less than 4 feet at a minimum with wider space desired in locations with significant pedestrian activity.
- Wherever possible, sidewalk toilets should be placed at red curb zones that are not bus stops.
- Sidewalk restrooms should be placed such that they do not block scenic views.



Public art can be functional or include functional elements, such as an attractive bicycle rack or an element that includes seating.

- Sidewalk restrooms should not be located on a sidewalk fronting a restaurant, café, or any other eating establishment. Wherever possible, units should be placed out of the line of vision of any eating establishment. They are not recommended within 50 feet of an existing restaurant or an existing permitted sidewalk café or food market.
- The placement of the sidewalk restroom should not visually or physically obstruct the functioning of an existing, permitted flowerstand or sidewalk vendor.
- Sidewalk restrooms should not be located in front of a building entry and the entry to the restroom should be oriented away from the closest building entry when possible.

Sidewalk restrooms must conform to the guidelines outlined in Department of Public Works Order No. 163,369.

Traffic and Parking Signs

Traffic and parking signs convey essential information to drivers, cyclists, and pedestrians. However, if misplaced or overused, they may become too numerous, create a cluttered streetscape environment, and lose their efficacy as signage.

Location and Placement

Traffic and parking signs may be located in the edge zone or the furnishings zone. If located in the edge zone, they should be placed at either end of parking stalls. They should be aligned along the block.

Traffic and parking signs should not be placed so that they will be obstructed by other streetscape elements. However, other desirable elements such as street trees or light poles should not be moved to accommodate new signage; rather, signs should be placed around existing features and around the ideal locations of plantings, lighting, and site furnishings.

Signs may be placed within planters as long as they are concrete-set.

Consolidation

Traffic and parking signs should be consolidated onto single poles wherever possible. New signs should use existing poles wherever possible. Stand alone signs should only be located where no other sign exists within 100’.

When redesigning streets, designers should look for opportunities to consolidate existing signage onto shared poles.

Trash Receptacles

Location of Trash Receptacles

Trash receptacles should be located according to the following guidelines:

- Trash receptacles should be located near corners at intersection as near as is practicable but out of the corner clear zone
- Trash receptacles should be located near high activity generators such as major civic and commercial destinations
- Trash receptacles should be considered at transit stops and entries to transit stations
- There should be a maximum of one trash receptacle every 200 feet along commercial streets. Additional trash receptacles should be provided only if a private sponsor provides continued maintenance.
- A maximum of four trash receptacles should be provided at an intersection (one per corner)
- Trash receptacles should be placed in the furnishings zone near the throughway zone edge. When situated at the throughway zone edge, they can demarcate the free path of travel.

Design of Trash Receptacles

When selecting trash receptacles, they should be considered as a design element, and design should reflect aesthetic as well as functional concerns.



Sidewalk restrooms can be an important amenity for pedestrians, but they must be carefully placed to ensure adequate pedestrian circulation and that they not negatively impact adjacent land uses or views.



Trash receptacles should be conveniently located near high pedestrian traffic areas.



Wayfinding signage should be in locations with high pedestrian traffic and should be attractive, fitting in with the style of other street amenities, and easily usable to both residents and visitors.

Trash receptacles should be selected from the same or a similar design “family” as other site furnishings (such as benches, bollards, bike racks, etc.) and should be finished or painted to complement other site furnishings.

Trash receptacle construction should use durable, high-quality materials, such as galvanized or stainless steel. Materials should be painted to reflect colors similar to nearby elements. Material and paint selection should be graffiti resistant.

Trash receptacles should be able to open from the side to allow easy access for removal of garbage bags.

Wayfinding Signage

Wayfinding signage can help to orient and direct pedestrians, locals and visitors alike, to key destinations. It can also impart a distinct identity to a neighborhood or district. Wayfinding signage particularly benefits transit riders, helping to direct them from transit stops to nearby destinations and back.

On steep, inaccessible streets wayfinding signage can direct people to the nearest accessible route to reach the same destination.

Location and placement

A basic amount of wayfinding signage, such as street signs, is appropriate to any street; however, certain streets including those

that handle more visitors, such as downtown, ceremonial, or commercial streets, or those on which location, direction, or destination is less clear should include special wayfinding signage.

Wayfinding signage should be located in the furnishings zone. Signage should be located near as near to intersection corners as is practicable (but outside of the corner clear zone), public plazas, or other locations with high pedestrian activity. For larger signage, see guidance on Kiosks and Gateway Monuments (this section).

Wayfinding signage should not be located on historic streetlight poles.

Design and Communication

Wayfinding signage should clearly indicate locations of nearby destinations, by means such as arrows or vicinity maps.

Wayfinding signage should be easy to spot from far away, but designed to be read from near by a pedestrian. It should include direction and distances to nearby destinations, including transit, retail districts, and civic and cultural attractions. A city map clearly showing current location and the best routes to nearby destinations should also be considered.

Signage dimensions should be kept at a pedestrian scale and demonstrate a high level of detailing and craftsmanship.



HISTORIC/ADVENTURE TRAIL MARKINGS

Historic and adventure trails highlight unique city spaces, such as historic, civic and cultural destinations, parks and open space, and unique streets, trails, stairs, and paseos. They can be integrated into sidewalk pavement, the sides of buildings, poles, or public art or other special furnishings to add unique detail and an educational dimension to the streetscape. Trails can be located on any street, and will often cross many street types, plazas, and open spaces as they meander through the city. Trail signage should be complemented by maps, brochures, and other information that can be taken away by people who use the trail. Sidewalk markings are permitted through DPW, and applicants are responsible for their maintenance..

Flexibility should be granted to artisans and craftspeople who may wish to create unique signage that may contribute to a sense of place. Signs that highlight local district or neighborhood character should be encouraged and should be of a similar look and feel throughout that district to enhance the sense of the areas identity.

Externally illuminated signs should be used to illuminate signs and not pedestrians, minimizing glare. Reflective coating should be used to minimize glare. Internally illuminated signs should be avoided as they are typically designed to attract drivers and are too intense for pedestrians.

Wayfinding signage should be in the same design palette as other street furnishings.

When not designed as a unique design element, wayfinding signage should use existing poles wherever possible. Signage should be integrated into larger streetscape elements, such as kiosks and gateway monuments where possible.



Special signage can be an important part of defining a unique identity for a commercial district or other destination.





6.6

UTILITIES AND DRIVEWAYS

Utilities

Utilities in the streetscape consist of utility poles and overhead wires, surface-mounted utility boxes, utility mains, laterals, and vaults or valves. They include sewer, water, gas, and telecommunications, as well as traffic signals, street lights, and Muni poles and wires.

Utility installation can occur as a new installation (on new streets or as a part of new development), retrofit or upgrade to an existing system (such as undergrounding of overhead wires or sewer upgrades), or emergency repair. Utility installations, upgrades, consolidation, rearrangements, or realignments may also occur as part of other street improvement or sidewalk improvement projects.

Utilities are a necessary and ubiquitous element of streetscape environments. Though essential, utilities often constrain the ability to locate other streetscape elements and can create a disorderly visual environment. Conversely, other streetscape elements may conflict with the ability to access and maintain utilities.

Well-organized utility design and placement can lead to:

- Minimization of streetscape clutter to achieve a cohesive streetscape design
- Maximization of space for plantings
- Improved efficiency of utilities and integrated alignment with stormwater facilities, street furnishings, and street lighting

Shotwell Street ▼



- Reduced cutting and trenching
- Possible reduction of long-term street and sidewalk closures
- Reduced long-term maintenance conflicts and potential costs
- Improved pedestrian safety, quality of life, and right-of-way aesthetics

Guidelines

Locating Utilities

Utilities should be placed to minimize disruption to pedestrian through travel and potential planting and site furnishing locations while maintaining necessary access for maintenance and emergencies, per the following guidelines:

Roadway/Parking Lane: Large utility vaults such as network or transformer vaults, and conduits running the length of a city block, should be located in the roadway or parking lane where access requirements allow. Vaults in the parking lanes should be striped as a temporary parking area, in a no parking zone, or in front of driveways.

Utility vaults located in the street must be rated to City loading standards (e.g. DOT truck loading requirements).

Driveways: Utility vaults such as residential water vaults, residential water meters, gas valves, gas vaults, street lighting, or other “Christy” boxes should be located in driveways wherever possible. Larger utility vaults such as transformer vaults should be placed in driveways where width allows.

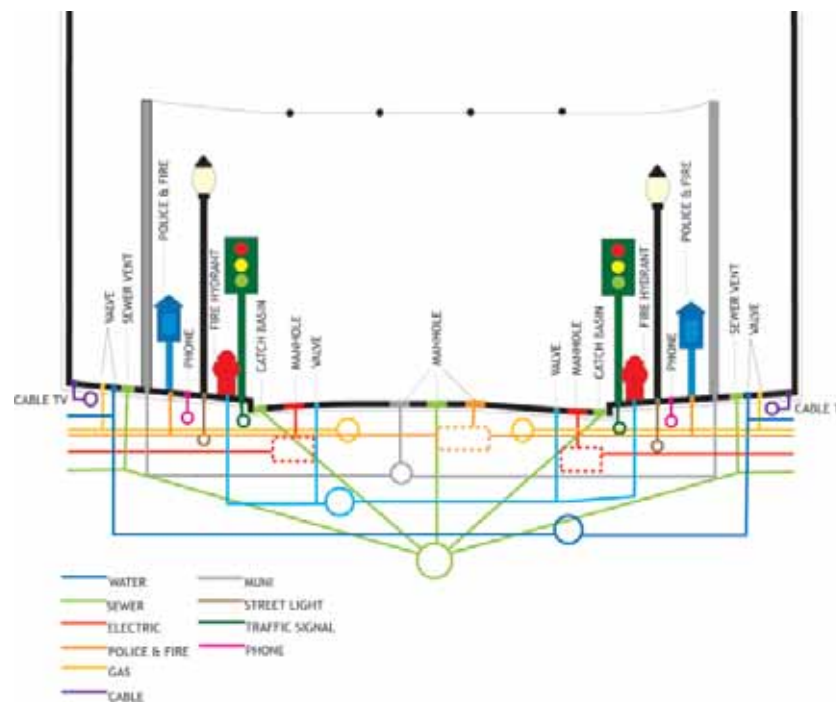
Utility laterals should run through driveways and other zones where tree planting locations are already limited wherever possible, rather than directly under planted areas.

Edge Zone: Small utility vaults such as residential water vaults, residential water meters, gas valves, gas vaults, street lighting, or other Christy boxes should be located in the Edge Zone wherever possible.

In the Edge Zone, Christy boxes should be placed with the longer side parallel to the curb. “Christy boxes” should be aligned for design consistency along a block or neatly clustered.

Furnishings Zone: Utility vaults and boxes should be located outside of the Furnishings Zone wherever possible to maximize the number and size of tree wells and the ability to connect tree wells into continuous strips.

Utility laterals should run adjacent to, not directly under, potential site furnishing and tree planting locations wherever possible (such as through driveways or between tree basins). Subsurface utility conduits and irrigation lines should avoid running under the length of the planting area to minimize root interference. Water meters should also be located outside this zone where possible to avoid interference from tree roots..



Existing utility alignments in the streetscape



Utility vaults can be located within planting areas as long as they can be accessed.



Many streets have few or no trees for entire block lengths because subsurface utilities limit the ability to plant



APPROPRIATE UTILITIES BY SIDEWALK ZONE

	SMALL UTILITY STRUCTURES								LARGE UTILITY STRUCTURES					
	Sewer Vents	Sewer Clean-outs	Water Valves	Water Vaults	Water Meters	Gas Valves	Gas Vaults	Street Lighting (Christy Boxes)	Utility Laterals	Irrigation Lines	Utility Conduits	Large Electrical Utility Vaults	Large Telephone Utility Vaults	Combined Dry Utility Vaults
Edge Zone And Driveways	●	●	●	●	●	●	●	●	●	○	○	✗	✗	○
Furnishings Zone	○	○	○	✗	✗	○	✗	○	○	○	○	✗	✗	✗
Throughway Zone	○	○	○	○	○	○	○	○	○	●	●	●	●	○
Frontage Zone	○	○	○	○	○	○	○	○	○	○	○	✗	✗	○
Pedestrian Crossings	✗	✗	✗	✗	✗	✗	✗	○	✗	✗	✗	✗	✗	✗
Curb Extensions and Parking Zone	✗	✗	✗	✗	✗	✗	✗	○	✗	○	✗	✗	✗	✗
Streets	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	●	●	●	●

● Preferred ○ Acceptable ✗ Not Recommended

If several shallow utility laterals are unavoidable, planting areas may still be created and should utilize ground cover or low shrub plantings without the incorporation of deep rooted trees, per Urban Forest, Section 6.1.

In the Furnishing Zone, “Christy” boxes should be placed with the longer side perpendicular to the curb.

Surface-mounted utilities may be located in the Furnishings Zone, per DPW Director’s Order #175,566. Surface-mounted utilities such as hydrants and air valve enclosures must be set on a concrete base if located within planted areas

Throughway Zone: Utility vaults and conduits running the length of the city block may be located in the Throughway Zone – this location is preferable to the Furnishings Zone, but less preferable than the Edge Zone or Parking Lane. Vaults in the throughway zone should meet DPW guidelines for slip-resistant covers – DPW Director’s Order #176,112.

Large utility vaults should be placed at least 3 feet from building and 4 feet from curb where sidewalk widths allow.

Surface-mounted utilities should not be located in the Throughway Zone.

Frontage Zone: Utility vaults and valves may be placed in the Frontage Zone. Placement of utility structures in this zone is preferred only when incorporating utility vaults into the Edge Zone is not feasible.

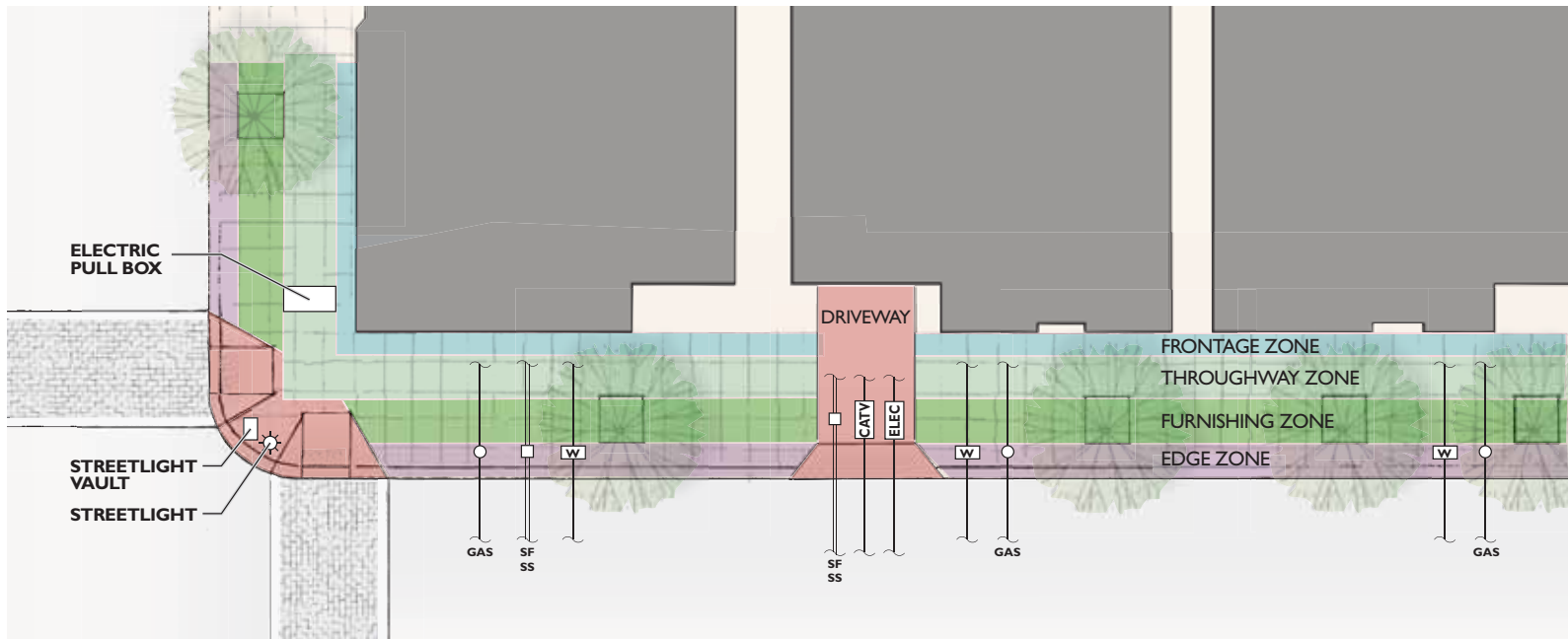
In the Edge Zone, Christy boxes should be placed with the long edge parallel to the curb.

Utility vaults in the Frontage Zone should not be located directly in front of building entrances.

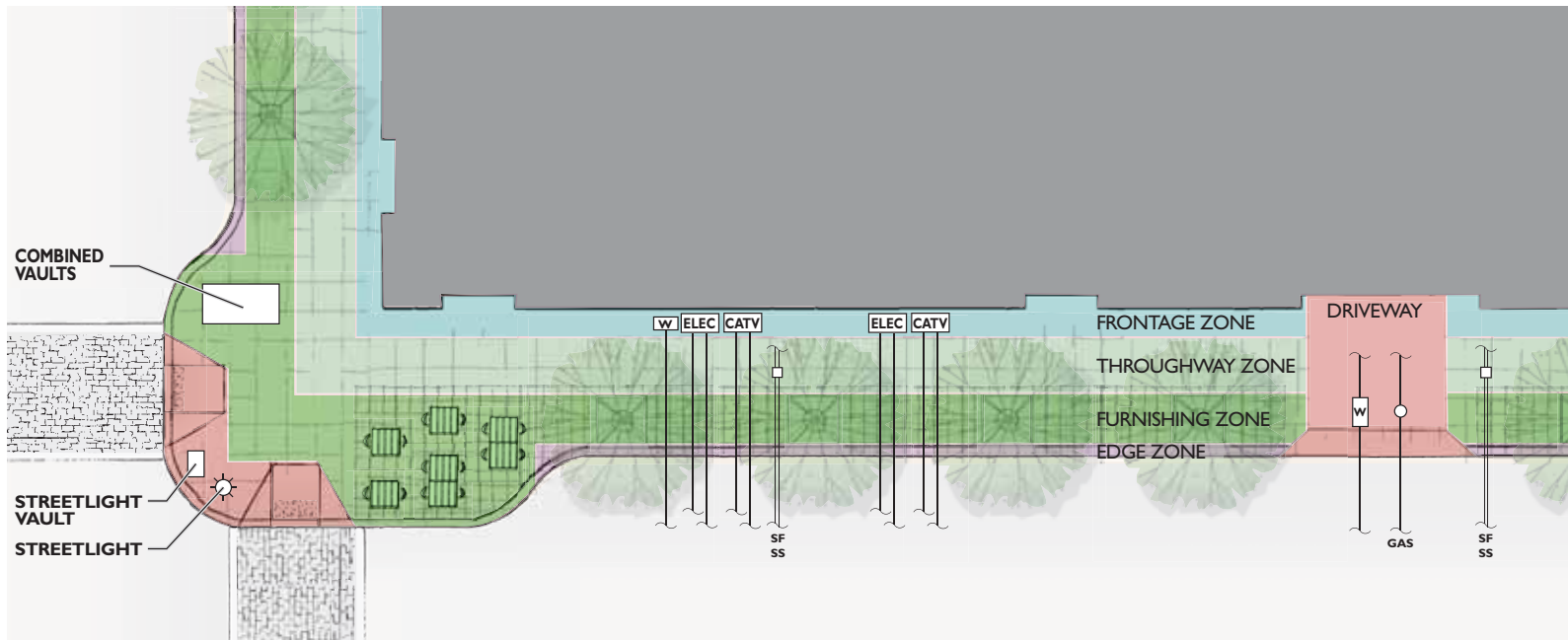
Pedestrian Crossings and Curb Ramps: New utility structures should not be placed within street crossing and curb ramp areas wherever possible.

If existing vaults conflict with ramp areas, vaults should be moved or modified to meet accessibility requirements as feasible as part of utility upgrade projects.

Catch basins and surface flow lines associated with storm drainage systems should be located away from the crosswalk or between curb ramps. On new streets, catch basins should be located upstream of curb ramps.



RECOMMENDED
UTILITY LOCATIONS
FOR RESIDENTIAL
STREET TYPES



RECOMMENDED UTILITY
LOCATIONS FOR ALL
OTHER STREET TYPES
(INCLUDING DOWNTOWN
RESIDENTIAL)

Note: Utility locations are for representation only and must be placed per City and County of San Francisco Standards and PG&E Green-book Standards.

UTILITIES PERMITTING IN SAN FRANCISCO

Public utilities (e.g. PG+E, Comcast, ATT, etc.) all have franchise agreements with the state and do not require a city encroachment permit; however, they require an excavation permit and are subject to the Excavation Code, and Surface-Mounted Utility guidelines (DPW Director's Order #175,566).

Privately installed utilities do not fall under the state franchise agreements and are required to get a major encroachment permit for major streetscape or capital improvement infrastructure projects.

City utilities (water, sewer, street lighting, and traffic signals) need an excavation permit but not an encroachment permit.

The Fire Department does not require a permit from Bureau of Streets and Mapping for water infrastructure.

Curb Extensions: Utility vaults and valves should be minimized in curb extensions where plantings or site furnishings are desired.

Surface-mounted utilities may be located in curb extensions outside of crossings and curb ramp areas to create greater pedestrian through width.

Utility mains located in the parking lane, and laterals accessing properties may pass under curb extensions.

In some instances, the construction cost of a new curb extension may be reduced by installing a removable cover (trench grate, pavers, concrete etc.) over a surface drainage channel to maintain existing drainage patterns, eliminating the need to move a catch basin. (See Section 5.3: Curb Extensions.)

With curb extensions or sidewalk widenings, utilities such as water meters, or sewer vents may remain in place as it may be cost-prohibitive to move them.

Consolidation

Utilities should be consolidated for efficiencies and to minimize disruption to the streetscape, per the following guidelines:

- Dry utility lines and conduits (telephone, CATV, electric, and gas, etc) should be initially aligned, rear-ranged or vertically stacked to minimize utility zones. Designers should refer to the Typical Distribution Trench schematic (from PG&E) for placement of joint utilities within a Public Utility Easement.
- Wherever possible, utility conduits, valves and vaults (e.g. PG&E, or street lighting and traffic signals) should be consolidated if multiple lines exist within a single street or sidewalk section.
- Dry Utilities (gas, telephone, CATV, primary and secondary electric, streetlights) should use shared vaults wherever possible. Shared vaults should be installed with predetermined color coded conduits per predetermined city set standards with a consideration for future public and private conduits. Private companies would have the option to purchase from the City or Utility any unused networks of existing conduit in-

lieu of installing a new a separate conduit route along a constrained street.

- Fiber Optic lines can be installed within active sewer trunk lines to minimize trenching.
- Surface-mounted utilities should share boxes wherever possible.
- Street lighting, traffic signal, and MUNI catenary poles should share poles wherever possible, and wherever doing so would not significantly alter the placement of these elements per the guidelines in other sections of this document. When retrofitting existing streets or creating new streets, opportunities to combine these poles should be created.

Design Guidelines

Street design and new development should consider overall pattern of plantings, lighting, and furnishings when placing new utilities in the street, and locate utility lines so as to minimize disruption to the prevailing streetscape rhythms per the following guidelines:

- Utilities should be located underground wherever possible, as opposed to overhead or surface-mounted.
- New utilities should use durable pipe materials that are resistant to damage by tree roots, such as ductile iron, polyethylene, or polypropylene pipes
- New utilities should use pipes with minimal joints
- Utility vault covers should be made of slip resistant materials, per DPW Director's Order #176,112.
- The City should use "trenchless" technologies, such as sealants, pulling cables through tunnels, etc. wherever possible, to avoid excavation and disruption of streetscape elements.
- New infrastructure projects should use resource-efficient utility materials, such as recycled PE conduit instead of PVC conduit, as stock materials deplete. Re-used or Recyclable materials should be incorporated wherever possible.

- Tree removal should be avoided and minimized during the routing of large-scale utility under-grounding projects
- Any utility-related roadway or sidewalk work should replace paving material in-kind (e.g. brick for brick) where removed during emergency or construction
- Where landscaped medians are realigned or created during a major street improvement project, existing combined sewer manholes should be raised (6-inch above finish grade) to form an overflow drain inlet within a depressed planted median. This would create a stormwater facility using the existing infrastructure. Catch basin laterals may then be removed as allowable.

Access and Maintenance

Major Utilities (sewers, fire hydrants, gas and water meters and mains, manholes and utility vaults, utility poles, and parking meters) should be installed at least 5 feet from the edge of existing or proposed tree basins.

Minor Utilities (laterals, Christy Boxes, valves, etc) should be installed at least 3 feet from the edge of new or existing tree basins.

Utility Poles must be accessible by 3' path.

Refer to City and County of San Francisco Standard Plans and Excavation Code for utility installation standards.

New Development and Major Redevelopment

Within new development and major redevelopment areas:

- Where appropriate, the City should support the installation of separate stormwater and wastewater collection systems in areas where not already implemented by SFPUC
- New residential development areas should incorporate alleys for vehicle, utility, and service access so as to enable a more consistent streetscape and minimize above-ground utilities

- New development should locate utilities to minimize disruption to streetscape elements

Abandonment

Currently abandoned dry conduits should be reused or consolidated if duplication of lines are discovered during street improvement projects. Utilities should be contacted for rerouting or consolidation ("Application for Relocation / Rearrangement"). Where it is not possible to reuse abandoned mains, conduits, manholes, laterals, valves etc., they should be removed per agency recommendations when possible in order to minimize future conflicts.

Abandoned water and sewer lines may be retrofitted as dry utility conduits where available or if possible to minimize the need for future conduit installations.

Process

Utilities should be installed during a full-street, half-street, or full or partial sidewalk improvements rather than a separate utility cut wherever possible.

New development should submit utility plans with initial development proposals so that utilities may be sited to minimize interference with potential locations for streetscape elements.

Utility installation or repair should be conducted from the bottom up; scheduled utility installation or repair should occur prior to planned street reconstruction or major streetscape improvements.

The City should use major utility work as an opportunity to build streets back to desired conditions, per Better Streets Plan guidelines.

BEST PRACTICE: NEW YORK CITY HIGH PERFORMANCE INFRASTRUCTURE GUIDELINES

NEW YORK, NEW YORK

The New York City High Performance Infrastructure Guidelines provide a roadmap for incorporating street wide best management practices (BMPs) into New York City's right-of-way infrastructure capital program. They are written for the Department of Design and Construction (DDC), but they are just as useful for by planners, designers, engineers, public officials, and all other services involved in constructing, operating, or maintaining the right-of-way.

The guidelines act as the first step toward improving design collaboration while enhancing environmental, social, and economic outcomes for the City's infrastructure investments.

See <http://www.nyc.gov/html/ddc/html/ddcgreen/high-perf.html>



Top: On many streets, frequent utilities and driveway curb cuts reduce the ability to plant trees, resulting in a barren streetscape.

Bottom: Permeable pavers and other materials can allow stormwater to infiltrate through driveways and add a more attractive diversity of materials and textures to the streetscape.



Driveways

Driveways allow necessary access across the sidewalk to residential and commercial garages. However, they present potential conflicts between drivers and pedestrians and increased possibility that pedestrian through travel will be compromised.

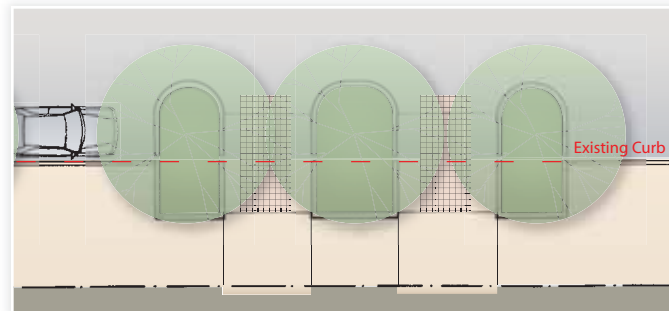
In many areas, the high number of driveways and width of driveway curb cuts reduces the available space for planting and other amenities. Improved driveway design can provide added space for planting to improve street aesthetics.

Guidelines

Driveways should be designed to minimize impact on through travel or pedestrian use of the sidewalk.

Driveway curb cuts for individual residential properties should not be wider than 7 feet with 1 1/2 foot wings (10 feet total width). Where truck loading is the dominant activity, they should not be wider than 8 feet with 1 1/2 foot wings (11 feet total).

Driveway curb cuts for two-way traffic should not be wider than 18 feet. An exception should be made on industrial streets in locations requiring frequent access for large trucks or semi-tractor trailers, where two-way driveway curb cuts may be up to 24 feet.



Parking-lane planters can be located between driveways where space is too narrow to allow a vehicle to park. Where planters extend into the sidewalk furnishings zone, they can be designed to occupy the space of driveway wings, narrowing the driveway and widening the planting area.

DPW standard plans for driveways should be consulted for engineering standards for driveway construction.

Curb cuts are discouraged in pedestrian-intensive areas. Reducing driveways reduces the number of conflict points between pedestrians and vehicles and can dramatically improve safety.¹

Wherever possible, commercial, industrial, and large residential properties should consolidate driveways and reduce overall parking requirements by interconnecting parking lot and loading area entries and by sharing parking among uses. Where residential garages and adjacent lots are located on adjoining lot lines, driveways should be combined into a single cut.

In areas of San Francisco where alleys provide access to the rear of properties, curb cuts onto streets are strongly discouraged; all parking and service access should be provided via the alley.

On new streets, alleys should be provided, minimizing the need for new driveway cuts on primary streets.

Because driveways handle relatively low volumes of traffic, alternative surfacing materials including unit pavers and other permeable materials may be installed in driveways. The clear through-way zone of the sidewalk should be a continuous material.

Driveways may be bounded by permeable paving, curb extensions or landscaping areas that extend from the sidewalk into the parking lane, eliminating the need for driveway aprons.

¹ Source: <http://www.ctre.iastate.edu/research/access/toolkit/3.pdf>. See also pages 11-13 of the following document: www.ctre.iastate.edu/PUBS/tsinfo/ts1-6.doc <http://www.ctre.iastate.edu/PUBS/tsinfo/ts1-6.doc>