Green Infrastructure Design Guide

First Edition | 2019

Buildings and Sites Design Strategies Overview

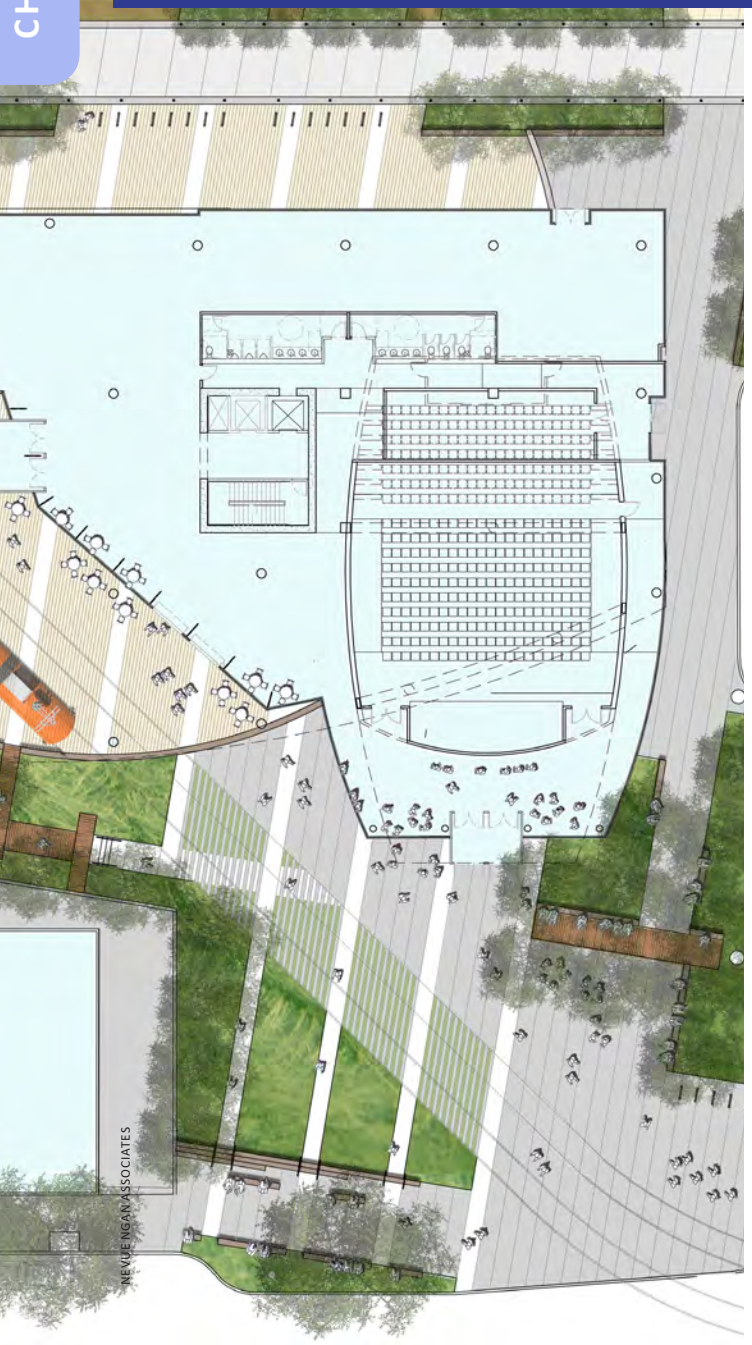
Urban Rain | Design Inc.
The Office of Kevin Robert Perry, FASLA

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

CHAPTER

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies



The Importance of Efficient Site Design

- Has the impervious area from sites, parking lots, and/or buildings been minimized? From a design perspective, there are several effective strategies to minimize these areas.
- A carefully thought out site plan will often yield the space for a stormwater facility(s) that fits seamlessly with the other site uses.
- This holds true for new sites, parking lots, and buildings, but is especially evident when designing street and parking lot retrofit projects.

Providing Efficient Design for Sites

- Cluster buildings and mix building use to reduce the length of streets and driveways, minimize land disturbance, and protect natural areas.
- Integrate parking within the building structure or provide separate parking structures.
- Do not “overpave” sidewalks, walkways, driveways, and/or plaza spaces, but do not over pave the site with these elements.
- All the strategies mentioned above help save space for integrated and perimeter landscape spaces that can also be used as stormwater facilities.

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies

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Providing Efficient Design for Parking Lots

- Parking lots are also often designed with oversized parking stalls and travel/back-up aisles.
- Shorten parking stall lengths to 15 feet and/or shorten the drive/back-up aisles to 22 feet (this will most likely require revisions in municipal code)
- Portland, Oregon and other cities have allowed even smaller parking lot dimensions within their city codes. These strategies are especially effective for creating landscape space in parking lot retrofits.
- As municipal requirements allow, parking lots can provide for the average day (as opposed to peak) condition, or at least can provide peak overflow parking zones with pervious pavement.
- Consider parking lots in the future that may be used far automated vehicles.
- All the strategies mentioned above help save space for integrated and perimeter landscape spaces that can also be used as stormwater facilities.

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies

GOOGLE EARTH

▲ *The Brisbane City Hall site prior to retrofitting with a new parking lot and building landscape space was very inefficient in its layout.*

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies

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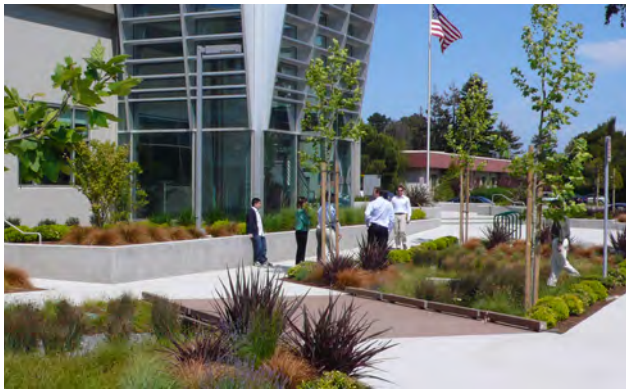

KEVIN ROBERT PERRY

▲ *After the retrofit, the Brisbane City Hall replaces under-utilized asphalt with a new rain garden without losing any parking spaces.*

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies

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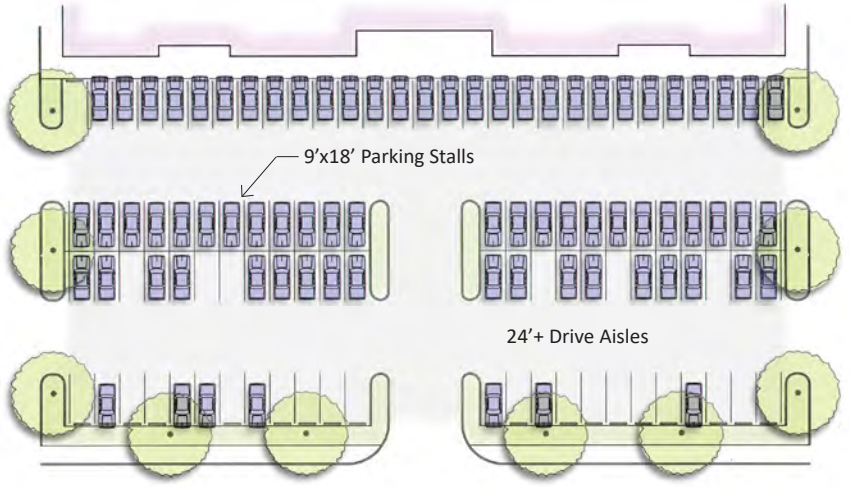
▲ *This gas station parking lot in San Mateo Conty provides a stormwater planter within a confined space used for capturing runoff.*

URBAN RAIN DESIGN

▲ *This site development installed a vegetated swale to manage both building and parking lot runoff.*

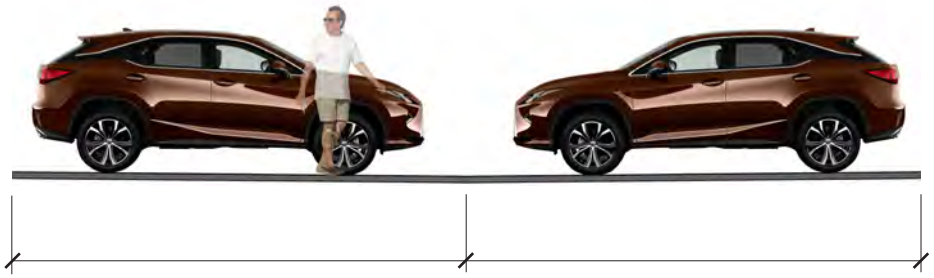


Oversized Parking Lot Dimensions

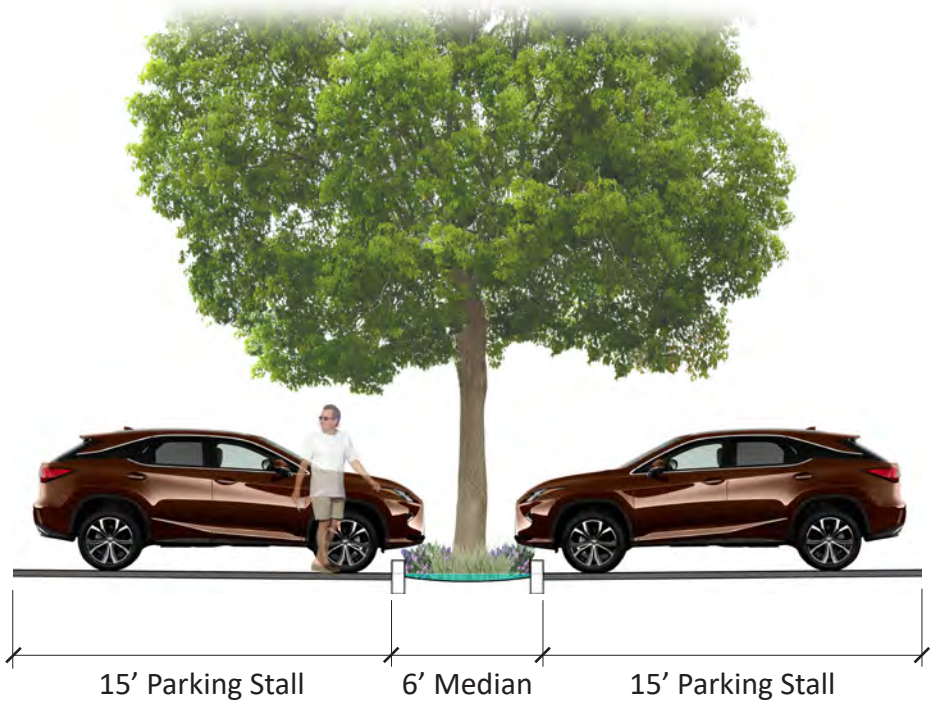
Efficient Parking Lot Dimensions

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies



▲ *This typical cross section illustrates a conventional parking lot condition with 18 feet long parking stalls.*



▲ *This cross section shows how a 15 feet parking stall can help create room for landscaping used for stormwater management. Note that the parked cars in both scenarios are placed in the same place and fit within reduced length the parking stalls.*

NEVUE NGAN ASSOCIATES

▲ *This parking lot is oversized based on its parking demand and has an inefficient layout. The result is a considerable amount of impervious area.*

KEVIN ROBERT PERRY

▲ *This parking lot was redesigned to efficiently use space yielded a vegetated swale, sidewalk, and landscape zone for street trees.*

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Buildings and Sites Design Strategies

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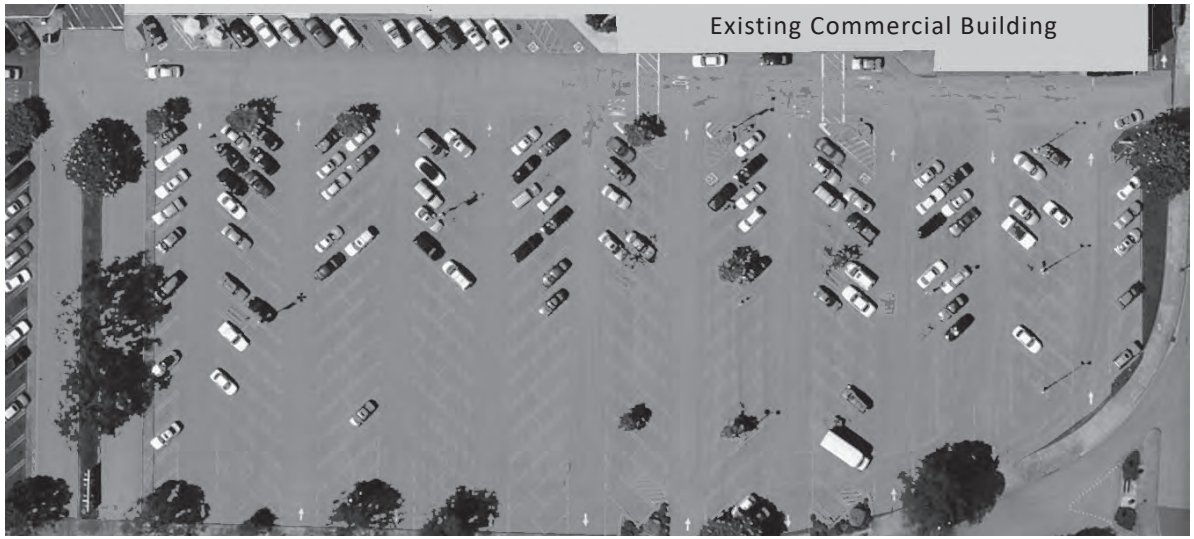
Efficient Site Design for Large-Scale Sites

- There are many opportunities in San Mateo County for large development sites and parking lots to be redeveloped with a more efficient site design.
- Typical large parking lot in San Mateo County immediately adjacent to El Camino Real. One can see in the photo the vast amounts of pavement with only a small percentage of the parking spaces being occupied.
- The plan on the opposite page illustrates how a commercial site like the one shown can be reorganized with a more efficient site design and retrofitted for various stormwater facilities.



GOOGLE EARTH

▲ *An aerial view of a typical large shopping mall parking lot in San Mateo County.*

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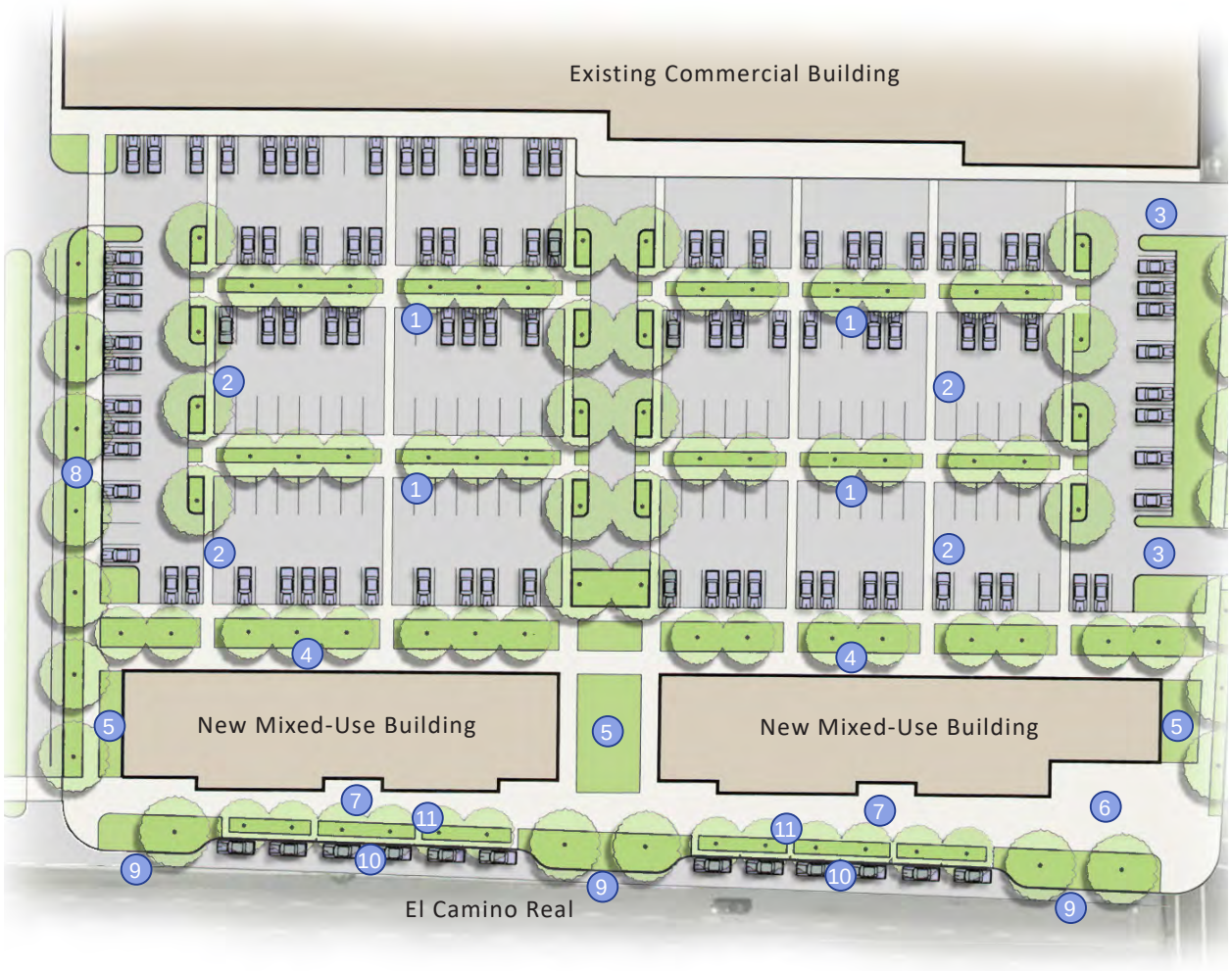

▲ *This is the same shopping mall site illustrating how much space can be repurposed to landscape, stormwater, pedestrian circulation, and even new building footprints when utilizing a more efficient site design.*

Key Design Elements

1. New stormwater planter/vegetated swale systems with enhanced pedestrian circulation
2. Defined pedestrian walkways throughout parking lot
3. Secondary parking lot entrances
4. Vegetated swales capture runoff from both the parking areas and building rooftops
5. Rain gardens for building runoff
6. Plaza space in front of new retail building
7. Comfortable sidewalk zone along El Camino Real
8. Vegetated swale captures drainage from parking lot and primary entrance road
9. Stormwater curb extensions capture runoff from El Camino Real
10. On-street parking in front of new retail
11. Stormwater planters can either capture runoff from El Camino Real or adjacent retail

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Buildings and Sites Design Strategies

Balancing Parking Spaces with Landscape Space

- Incorporate as much green space as possible in order to better manage stormwater runoff.
- The best green parking lot designs should provide balance between parking and landscape space.
- Some parking loss might be acceptable or even desirable if the overall parking lot condition has a stronger aesthetic appeal.

NEVUE NGAN ASSOCIATES

▲ *This parking lot has significant amounts of landscape area balanced with parking spaces.*

URBAN RAIN DESIGN

▲ *A parking lot in Sacramento incorporates a vegetated swale and sites tree islands every two to three parking stalls to help shade asphalt surfaces.*

LES VICTOIRES DU PAYSAGE

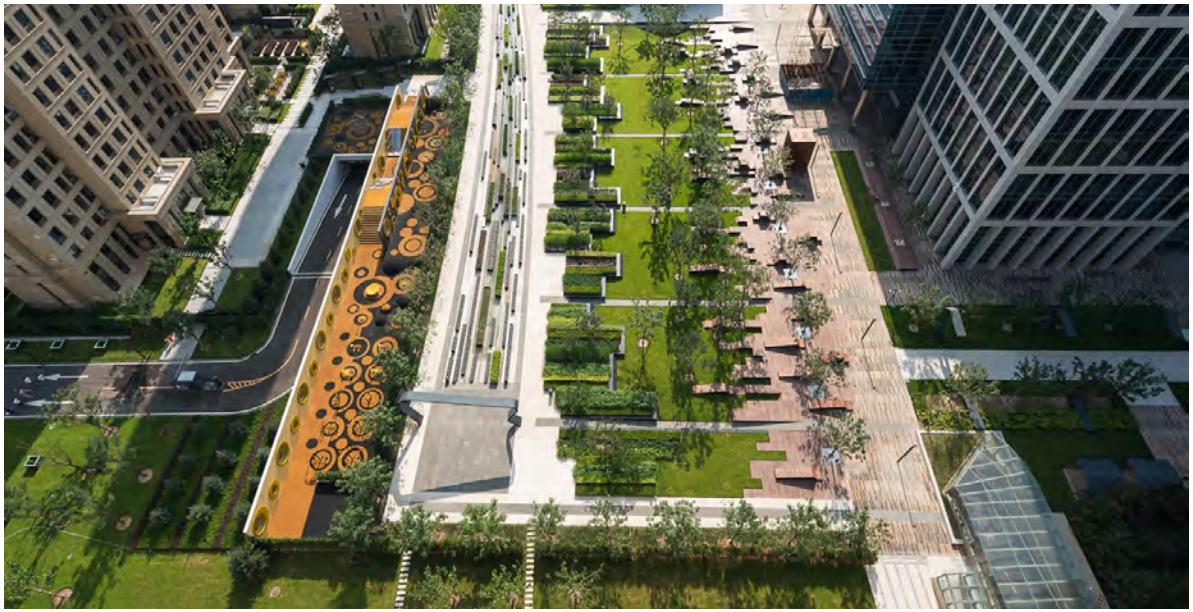
▲ *This innovative parking lot example in Strasbourg, France boldly greens the parking lot with trees, pervious pavement, stormwater planters, and provides superb pedestrian circulation. This is an excellent example of balancing parking spaces with landscape and people space.*

3.2 Design Strategies and Guidelines

Buildings and Sites Design Strategies

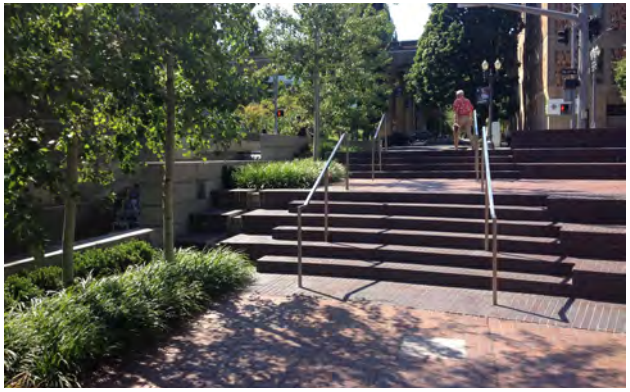
Balancing People Spaces with Landscape Space

- The best places for people to live, work, or shop often have a vibrant landscape associated with them even in the most urbanized settings.
- A functional landscape space should be a valuable placemaking component.
- Rain gardens, stormwater planters, green roofs, green walls, and other landscape-based stormwater strategies can be strategically designed to fit and complement hardscape elements.



MARTHA SCHWARTZ PARTNERS

▲ *This project in China shows the potential to green entire city blocks while still creating a beautiful balance between pedestrian space and landscape space. This project manages all of its stormwater runoff on site.*



URBAN RAIN DESIGN

▲ *A narrow stormwater planter is strategically cut into a staircase without impacting pedestrian flow.*

MARTHA SCHWARTZ PARTNERS

▲ *In this example, the hardscape is the leftover space, while the landscape dominates providing maximum potential to manage stormwater runoff.*

CHAPTER

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Existing Site Conditions in San Mateo County

There are various building, site, and parking lot conditions that generate stormwater runoff in San Mateo County. These distinctions are important to consider because the successful design of green infrastructure responds to the context, opportunities, and constraints found in differing land use conditions.

Six general site types can be described for San Mateo County based on the surrounding land use context. They are:

- Low-Density Residential Sites
- High-Density/Mixed-Use Residential Sites
- Large Commercial/Office & Industrial Sites
- Schools/Public Building Sites
- Parks and Plazas Sites
- Small and Large Parking Lots

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Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *A typical low-density residential yard in San Mateo County.*

Low-Density Residential Sites

- Low-density residential sites offer some of the best opportunities for green infrastructure design solutions.
- Fewest conflicts with utilities
- Greatest ability to retrofit under-performing landscape space or modify existing landscape space for stormwater management.

GOOGLE EARTH

▲ *This aerial photo illustrate the impervious area that generates runoff from low-density residential sites.*

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Buildings and Sites Design Examples for San Mateo County

High-Density/Mixed-Use Residential Sites

- There is currently a significant emphasis on infill development along under-performing parcels and arterial streets in San Mateo County.
- High competition for space will require more urban solutions to green infrastructure.
- Pervious pavement and narrower stormwater planters could be used alone or in conjunction with landscape solutions in high-density residential conditions.

URBAN RAIN DESIGN

▲ *A typical high-density residential site in San Mateo County.*

GOOGLE EARTH

▲ *This aerial photo illustrate the impervious area that generates runoff from high-density residential/mixed-use sites.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *A typical commercial office building site in San Mateo County.*

Large Commercial/Office & Industrial Sites

- Common features include large building and parking lot footprints, perimeter landscaping, and single-story rooftops with little or no building shading.
- The combined large amounts of impervious area and under-performing landscape provides a great opportunity to manage stormwater runoff with various green infrastructure techniques.

GOOGLE EARTH

▲ *This aerial photo illustrate the impervious area that generates runoff from commercial/ office/industrial sites.*

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Buildings and Sites Design Examples for San Mateo County

Schools/Public Building Sites

- Typically have both large amounts of stormwater runoff associated with buildings, playgrounds, plazas, walkways, and parking areas.
- They also usually have perimeter landscaping, open landscape space, ancillary paved areas that can be redesigned with green infrastructure strategies.
- Schools and public building sites such as city halls, libraries, public works facilities offer a highly visible canvas to display and educate visitors on urban watershed issues and solutions.

URBAN RAIN DESIGN

▲ *A typical school site in San Mateo County.*

GOOGLE EARTH

▲ *This aerial photo illustrates the impervious area that generates runoff from a typical school campus.*

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Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *A typical neighborhood park in San Mateo County.*

Public Parks and Plaza Spaces

- Public park and plaza spaces in San Mateo County can also function on a higher level to manage on-site stormwater runoff, and in some cases, manage off-site stormwater runoff.

- There are opportunities to create green infrastructure projects within these parks and plaza spaces both with new development and in retrofit conditions.

GOOGLE EARTH

▲ *This aerial photo illustrate the impervious area that generates runoff from a low-density park condition as well as the amount of landscape available to capture stormwater runoff.*

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Buildings and Sites Design Examples for San Mateo County

Small and Large Parking Lots

- Smaller parking lots are the most difficult to retrofit because there is a high demand for available space, pervious pavement is a good choice.

- For larger parking lots, many are oversized for an average day's parking demand and can be easily redesigned with a variety of stormwater solutions.

GOOGLE EARTH

▲ *The red areas superimposed on this aerial photo illustrate the impervious area that generates runoff from large and small-scale parking lots.*

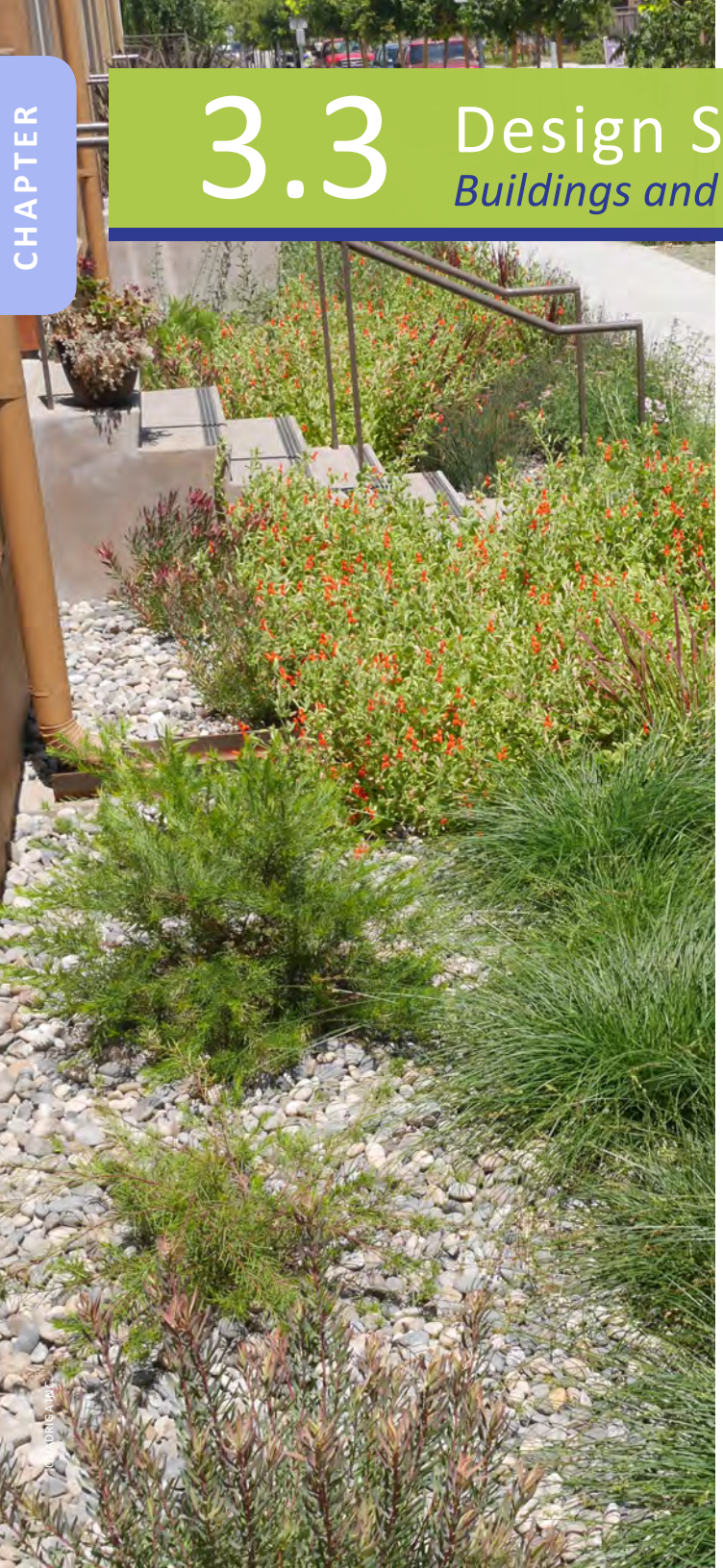
NEVUE NGAN ASSOCIATES

▲ *A typical large-scale parking lot in San Mateo County.*

CHAPTER

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County



What to Build and Where?

- This chapter illustrate common ways that vegetated swales, planters, rain gardens, pervious pavement, green gutters, rainwater harvesting, and green roofs can be applied to the variety of building, sites, and parking lot conditions found in San Mateo County.
- The examples shown are just a sampling of the many opportunities that exist in the region are not limited to the variety of potential green infrastructure solutions.
- Several “before and after” sketches show the potential for buildings, sites, and parking lot retrofit opportunities in San Mateo County.
- The examples shown are for reference only and are not “real” projects, but perhaps projects like those illustrated can be developed into future demonstration projects.
- The graphic on the opposite page provides a matrix for choosing what types of stormwater facilities are best suited for various conditions within San Mateo County. This is to be used as a general guide to acceptable design strategies based on land-use type.

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

	VEGETATED SWALE	STORMWATER PLANTER	RAIN GARDEN	PERVIOUS PAVEMENT	GREEN GUTTER	RAINWATER HARVESTING	GREEN ROOFS	GREEN WALLS	INFILTRATION SYSTEMS	INTERCEPTOR TREES
Low-Density Residential Sites	◎	◎ (site dependent)	◎	◎	◎	◎	◎ (site dependent)	◎ (site dependent)		◎
High-Density Residential/ Mixed-Use Sites		◎	◎	◎		◎	◎ (site dependent)	◎ (site dependent)	◎	◎
Commercial/Office & Industrial Sites	◎	◎	◎	◎		◎	◎ (site dependent)	◎ (site dependent)	◎	◎
Schools and Public Building Sites	◎	◎	◎	◎	◎	◎	◎ (site dependent)	◎ (site dependent)	◎	◎
Parks and Plazas Sites	◎	◎	◎	◎	◎	◎	◎ (site dependent)	◎ (site dependent)	◎	◎
Residential Driveways				◎	◎					
Large Parking Lots	◎	◎	◎	◎					◎	◎
Small Parking Lots	◎	◎	◎	◎	◎					◎

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical low-density residential home front yard in San Mateo County.*

WOOLY BLUE LANDSCAPE CONTRACTORS

▲ *EXAMPLE: An example residential yard rain garden captures roof runoff and features low-water plant communities.*

Low-Density Residential Vegetated Swale Example

Simply disconnecting downspouts, re-grading the landscape, and planting with drought-tolerant plant species can retain stormwater runoff on site during the wet season and become a beautiful dry garden during summer months.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same residential yard that converts un-watered grass areas into a rain garden with drought-tolerant landscaping. Roof downspouts direct water into the rain garden and a bridge connects the spaces.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Low-Density Residential Stormwater Planter Example

Another possibility to direct roof downspout runoff into landscape area next to driveways or alongside residential homes is to use stormwater planters. These planters do not have to be very deep and any excess runoff that can't be managed can overflow over the low points in the landscape.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same residential landscape that converts a grass areas into a stormwater planter with drought-tolerant landscaping.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical side landscape separating two residential properties in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example residential stormwater planter that captures roof runoff first into a rain barrel and an excess runoff is directed to a stormwater planter.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical low-density residential home front yard in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example of a residential front yard rain garden that captures site runoff and features low-water use plant communities.*

Low-Density Residential Rain Garden Example

Many front yards in San Mateo County are considered "blank slates" with little landscaping, and no street trees. With new rain gardens and street trees in place, front yards can be more ecologically diverse, absorb stormwater, and be more aesthetically pleasing.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same residential yard that converts un-watered grass areas into a rain garden with drought-tolerant landscaping. Roof downspouts direct water into the rain garden and a bridge connects the spaces.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Low-Density Residential Rainwater Harvesting Example

Rainwater harvesting for residential yards is an easy way to save water for irrigation during the fall and spring months. Rainfall can be captured in rain barrels and applied to the landscape during dry spells between storms.

URBAN RAIN DESIGN

▲ *EXISTING: A typical residential yard condition in San Mateo County.*

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same residential landscape that added a rain barrel to collect and re-use rainwater and converts a grass area into drought-tolerant landscaping.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example residential rain barrel that captures roof runoff first and then re-uses runoff to irrigate the adjacent landscape area.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical high-density residential home front yard in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example high-density residential building captures roof runoff and features low-water plant communities.*

High-Density Residential Stormwater Planter Example

The downspouts for new or existing high-density/mixed-use development projects an be disconnected into either raised or recessed stormwater planters. Some development projects are already utilizing stormwater planters next to buildings, while others, such as the retrofit opportunity shown below, can modify the landscape to accept stormwater runoff.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same high-density residential yard that disconnects roof downspouts and converts existing landscape areas into a stormwater planter with drought-tolerant landscaping.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

High-Density Residential Rain Garden Example

Adding a more dynamic rain garden landscape where space is available can help change the character of the site and provide a more functional space for the residents. This example illustrated below converts the existing lawn space into a rain garden with an integrated boardwalk and seating area. The roof downspouts direct runoff away from the building foundation to the rain garden using metal channels.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same high-density apartment complex that converts perimeter grass and landscape areas into a rain garden with drought-tolerant landscaping. Roof downspouts direct water into the rain garden.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical lawn space next to an apartment complex in San Mateo County.*

URBAN RAIN DESIGN

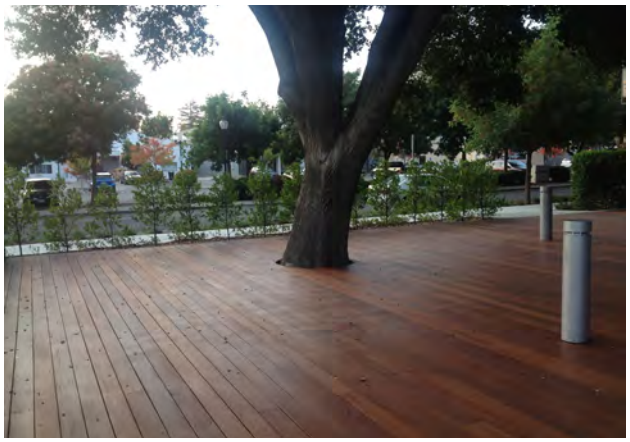
▲ *EXAMPLE: An example high-density residential rain garden captures roof runoff and features a boardwalk overlook and seating area.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

High-Density Residential Pervious Pavement Examples

Many high-density residential/mixed-used developments will need to use both landscape strategies and pervious pavement material to adequately manage on-site runoff. For pervious pavement, there are a wide variety of materials that can provide a viable walking surface and help infiltrate water into the soil.



URBAN RAIN DESIGN

▲ *EXAMPLE: A mixed use development uses a raised boardwalk allowing rainfall to pass through the decking and into the soil.*

URBAN RAIN DESIGN

▲ *EXAMPLE: A high-density residential building uses interlocking concrete pervious pavement at bike parking zones.*

URBAN RAIN DESIGN

▲ *EXAMPLE: This high-density residential apartment complex uses interlocking concrete pervious pavement throughout all of its walkways. This paving material choice also provides some visual appeal over standard concrete.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

High-Density Residential Vegetated Swale Example

A simpler approach with less concrete infrastructure is integrating shallow vegetated swales next to perimeter building landscape in high-density residential projects. Simply regrading and replanting to accommodate roof runoff is a cost-effective means to manage small amounts of drainage.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same high-density apartment complex that converts perimeter grass and landscape areas into a vegetated swale with drought-tolerant landscaping. Roof downspouts direct water into the landscape.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical lawn space next to an apartment complex in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example high-density residential vegetated swale captures roof runoff and features low-water plant communities.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

QUADRIGA INC.

▲ *EXISTING: A typical high-density residential rooftop.*

STREETEASY.COM

▲ *EXAMPLE: An example high-density residential building roof garden that provides stormwater management benefits and an outdoor meeting space.*

High-Density Residential/Mixed-Use Green Roof Example

New developments can easily build in green roofs, large or small, into the building programming; and these green infrastructure features can be combined with stormwater planters and rain gardens on the ground plane. In retrofit conditions, lighter-weight extensive green roofs can often replace existing conventional roofs offering building energy savings and a reduced urban heat island.

QUADRIGA INC.

▲ *RETROFIT OPPORTUNITY: The same high-density residential rooftop retrofitted with an extensive green roof condition.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

High-Density Residential Rainwater Harvesting Examples

Having larger building footprints, high-density/mixed-use buildings can generate significant amounts of stormwater runoff that can be directed to above-ground cisterns for future use. This water can be potentially used inside the building in bathroom toilets and urinals or can be applied as irrigation for outdoor landscaping.

JOHNSTON ARCHITECTS

▲ *EXAMPLE: A Seattle, Washington example of a proposed above-ground cistern incorporated into the "front yard" of a new high-density mixed-use building.*

PHILADELPHIA DEPARTMENT OF WATER

▲ *EXAMPLE: An example high-density residential above-ground cistern.*

TIMOTHY HURSLEY

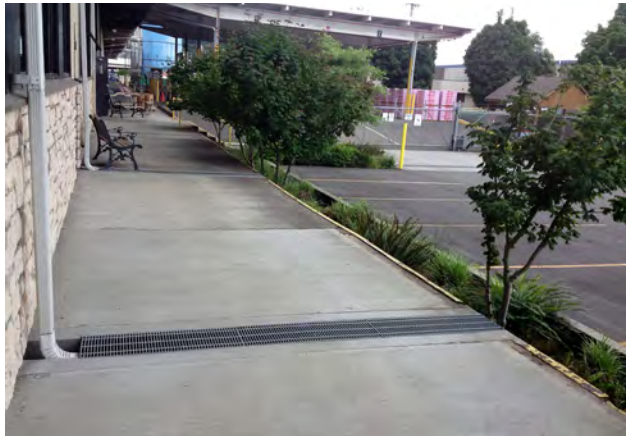
▲ *EXAMPLE: An example high-density residential above-ground cistern.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical landscape in a commercial zone in San Mateo County.*



URBAN RAIN DESIGN

▲ *EXAMPLE: An example industrial stormwater planter captures roof and sidewalk runoff via a trench drain.*

Office Building Stormwater Planter Example

Many landscapes adjacent to office buildings can be dramatically altered to not only manage stormwater, but to also provide a more inviting and invigorated street appeal to customers and workers. Refurbishing these left-over landscapes, and disconnecting downspouts into rain gardens and planters is a definite possibility in San Mateo County.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same office perimeter landscape converts un-watered grass areas into a stormwater planter with drought-tolerant landscaping. Roof downspouts direct water into the rain garden.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Industrial Warehouse Rain Garden Example

At many light and heavy industrial these sites in San Mateo County, landscape areas are often non-existent and the land cover is nearly 100 percent impervious. Creating pockets of green space in the form of rain gardens or stormwater planters can help manage roof and site stormwater runoff.

URBAN RAIN DESIGN

▲ *EXISTING: A typical large-scale industrial building site in San Mateo County.*

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same industrial building site redirects a series of downspouts into a new stormwater planter. These stormwater planters can help add much-needed trees into industrial building sites.*

URBAN RAIN DESIGN

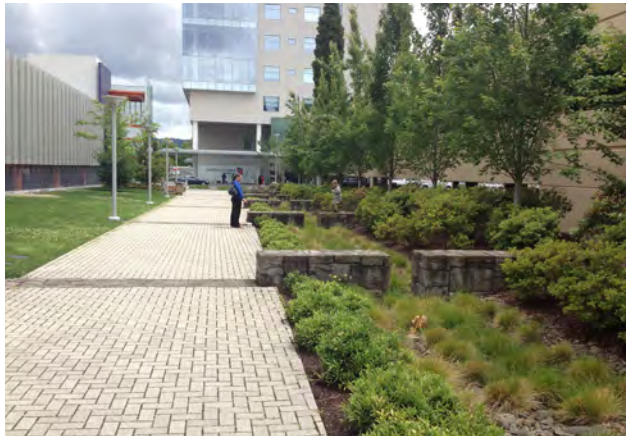
▲ *EXAMPLE: An example light-residential parking lot rain garden captures roof runoff.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical office side landscape in San Mateo County.*



URBAN RAIN DESIGN

▲ *EXAMPLE: An example office vegetated captures roof runoff and features a pervious paver sidewalk.*

Commercial Vegetated Swale Example

Simpler vegetated swales can also be placed along the frontages of many low-performing landscapes in San Mateo County. These landscape areas can often be retrofitted between existing vegetation such as perimeter shrubs and existing street trees.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same office perimeter landscape converts un-watered grass areas into a vegetated swale with drought-tolerant landscaping. Roof downspouts direct water into the vegetated swale.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Commercial/Industrial Green Roof Example

New and existing commercial, office, and industrial buildings can utilize green roofs to limit the amount of on-site stormwater runoff. If using lighter-weight extensive green roof technology, many of these existing building types can be retrofitted with minor structural enhancements depending on the building design and age.

QUADRIGA INC.

▲ *RETROFIT OPPORTUNITY: The same commercial/office building rooftop with a light-weight extensive green roof application.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical commercial/office building rooftop in San Mateo County.*

HYDROTECHUSA.COM

▲ *EXAMPLE: An office building with an extensive green roof application.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

School Green Roof Example

Schools can be selective as to what extent the various rooftops can be green roofs and these green roofs can be combined with other green infrastructure elements such as rain gardens and vegetated swales to provide additional stormwater treatment.

NEVUE NGAN ASSOCIATES

▲ *EXISTING: A typical school rooftop in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example university green roof captures rainfall and features low-water plant communities.*

QUADRIGA INC.

▲ *RETROFIT OPPORTUNITY: The same school rooftop retrofitted with an extension green roof system.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

School Pervious Pavement Example

Given the amount of space required for students to circulate and gather at school sites, there will always be a need for vast amounts of paving. However, these sites can and should as much as possible utilize pervious pavement material to allow water to soak into the ground and limit the amount of on-site stormwater runoff.

QUADRIGA INC.

▲ *RETROFIT OPPORTUNITY: The same school courtyard using pervious pavement to allow for rainfall to soak into the ground.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical school paved courtyard in San Mateo County.*

SOPHIE SUAVE

▲ *EXAMPLE: An example of a school walkway using interlocking concrete pervious pavement.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical schoolyard lawn in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example school rain garden captures roof and plaza runoff and features low-water plant communities.*

School Rain Garden Example

Many school sites in San Mateo County have large existing lawns/landscape space adjacent to buildings with exterior downspouts. These landscape areas can be altered to manage stormwater as well as break up the visual monotony of all lawn landscapes commonly found at school sites.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same school landscape that converts a portion of the lawn area into a rain garden.*

School Site Vegetated Swale Example

Schools often also have linear lawn/landscape space that can be easily regraded to create recessed areas designed for capturing and conveying stormwater runoff. In some cases, seating and outdoor classrooms can be built into the design of both vegetated swales and rain gardens.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same school site replaces a portion of the existing lawn with a meandering vegetated swale that features drought-tolerant landscaping.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical schoolyard lawn landscape in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example of a schoolyard vegetated swale.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical schoolyard building perimeter area in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example school stormwater planter captures roof and plaza runoff and features low-water plant communities.*

School Stormwater Planters

School sites have considerable amount of peripheral building spaces that are ideal to convert into stormwater planters. These types of space conversions reduce impervious area, reduce the urban heat island, and create additional seating/gathering spaces for students. These stormwater planters can be tucked against building facades or located adjacent to large asphalt play areas to accept stormwater runoff.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same schoolyard that converts a portion of its asphalt area into a stormwater planter.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

School Rainwater Harvesting

Many existing school buildings have exposed exterior downspouts that can be easily connected to a wide variety of rainwater harvesting systems. The scale of such systems can vary from simple 55-gallon rain barrels to several thousand-gallon rainwater tanks and cisterns. Rainwater harvesting at school sites are excellent tools to teach the value of water within the local watershed.

MARISA RODRIGUEZ

▲ *EXAMPLE: This 5,000-gallon rainwater harvesting system at the education building of the World Birding Center in Edinburg provides irrigation for nearby flowering plants and shrubs.*

WATERSTORAGETANKSINC.COM

▲ *EXAMPLE: A large 15,000 gallon cistern at Lake Travis Middle School near Austin, Texas is*

NEPONSET.ORG

▲ *EXAMPLE: The 2018 Canton High School Rain Barrel Project allows students to creatively paint rain barrels used to capture roof runoff.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A park lawn area with an existing inlet in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example park space rain garden captures site and sidewalk runoff and features low-water plant communities.*

Park Rain Garden Example

Existing park spaces are full of opportunities to convert under-used grass areas into stormwater landscapes. Simply look for inlet locations where the is not a lot of active use of the space to allow for larger rain gardens to capture and collect stormwater runoff.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same park landscape converts a portion of high water use lawn area into a rain garden with drought-tolerant landscaping.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Park Vegetated Swale Example

Existing spaces alongside pedestrian walkways in parks are great opportunities to introduce vegetated swales. These vegetated swales can help buffer active play zones with pedestrian pathways and can accept runoff from vast lawn spaces or adjacent impervious pathways.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same park and walkway condition with a vegetated swale replacing a portion of the lawn space.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical park lawn area alongside a walkway in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example vegetated swale in San Mateo County captures site and sidewalk runoff.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

URBAN RAIN DESIGN

▲ *EXISTING: A typical plaza space in San Mateo County.*

URBAN RAIN DESIGN

▲ *EXAMPLE: An example plaza rain garden captures sidewalk runoff and features low-water plant communities.*

Urban Plaza Rain Garden Example

Plaza spaces within public and private developments are great opportunities for retrofitting with green infrastructure as they often have excessive impervious area Many plazas have “dead zones” that do not need to be paved and can be replaced with stormwater landscape without compromising the programming of the space.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same plaza space converts under-used concrete areas into a rain garden with drought-tolerant landscaping.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Urban Plaza Stormwater Planter Example

Even narrower plazas/walkways can fit small-width stormwater planters instead of a sea of concrete. This helps soften the look of the space, and if trees are added, it can help shade plaza spaces. As with most plaza conditions, care should be taken to accommodate adequate pedestrian circulation through the space.

QUADRIGA INC./URBAN RAIN DESIGN

▲ *RETROFIT OPPORTUNITY: The same plaza space converts a portion of the space into a new stormwater planter. These stormwater planters can help add much-needed trees into barren plaza sites.*

URBAN RAIN DESIGN

▲ *EXISTING: A typical plaza/walkway site in San Mateo County.*

KEVIN ROBERT PERRY

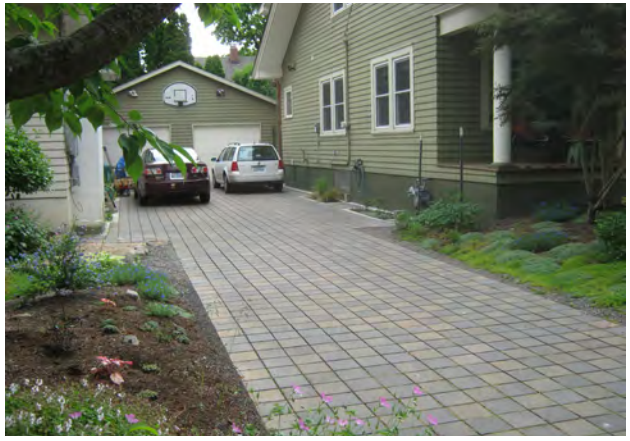
▲ *EXAMPLE: An example plaza/walkway with a stormwater planter and street trees.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

NEVUE NGAN ASSOCIATES

▲ *EXAMPLE: Interlocking concrete pervious pavers in a common shared driveway in San Mateo County.*



URBAN RAIN DESIGN

▲ *EXAMPLE: Interlocking concrete pervious pavers in a common shared driveway in a low-density condition.*

Full Residential Driveway Pervious Pavement Example

Residential driveways account for a large portion of area that are typically paved with impervious material. New and existing driveways can instead use pervious pavement materials such as interlocking concrete pervious pavers or pervious concrete.

URBAN RAIN DESIGN

▲ *EXAMPLE: A pervious concrete driveway in a low-density residential setting.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Residential Driveway Landscape Strip/Pervious Pavement Example

In many cases, the driveways can be partially paved to allow for just the wheels of vehicles to be on concrete and the remaining driveway to be an extension of the yard landscape or reinforced gravel or grass.

URBAN RAIN DESIGN

▲ *EXAMPLE: A partial concrete/landscape strip driveway in a low-density residential*

URBAN RAIN DESIGN

▲ *EXAMPLE: A partial concrete/reinforced gravel driveway in a low-density residential setting.*

KEVIN ROBERT PERRY

▲ *EXAMPLE: A partial concrete/reinforced grass driveway in a low-density residential setting.*

NEVUE NGAN ASSOCIATES

▲ *EXISTING: An angled parking lot example.*

Angled Parking with Vegetated Swales/Planters

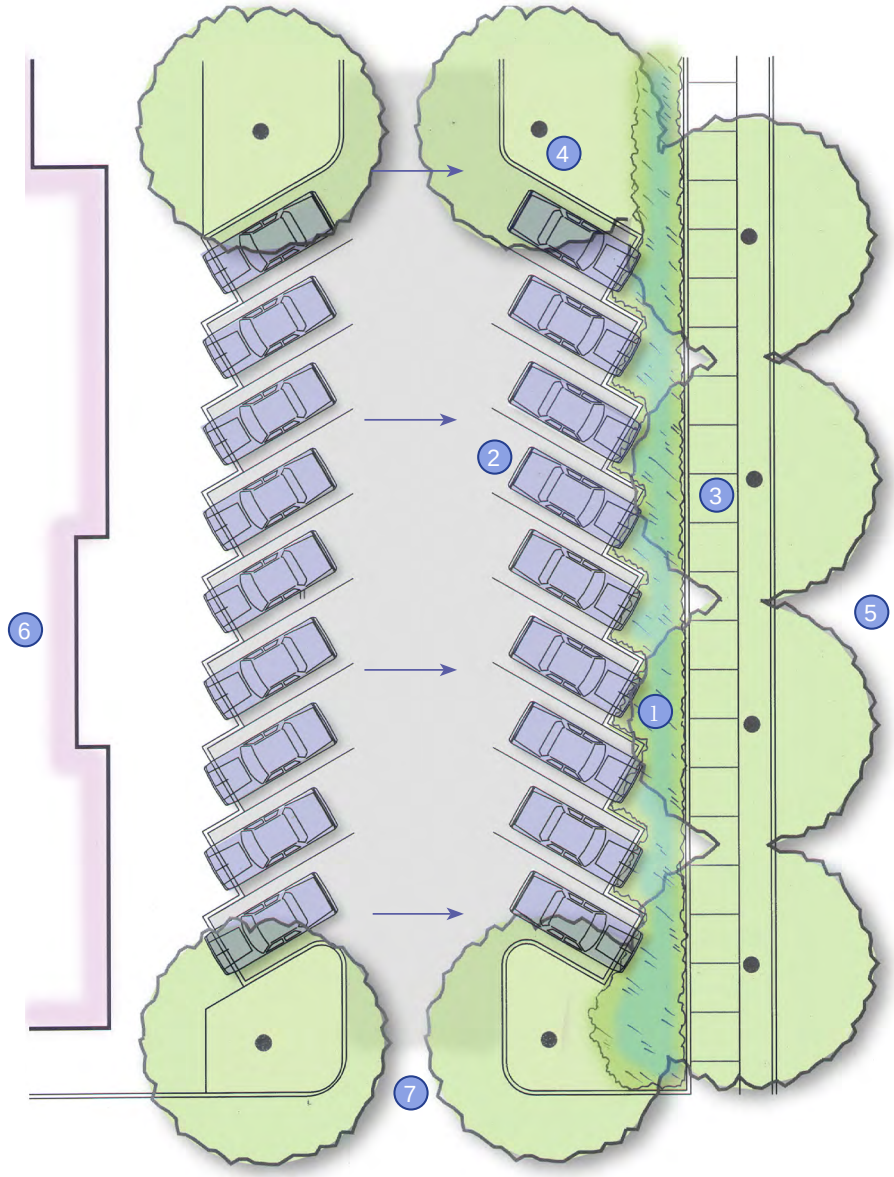
In this example, angled parking leaves unused space between the wheel stop and edge of an existing non-landscaped planter strip. Consolidating this left-over paved space into new landscaping can yield enough room for a parking lot swale. Under-utilized paved or landscape space may also exist in front of 90-degree, head-in parking.

NEVUE NGAN ASSOCIATES

▲ *RETROFIT OPPORTUNITY: The same parking lot retrofitted with a vegetated swale/ planter.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County



Key Design Elements

1. Stormwater planters within parking islands accept parking lot runoff.
2. 45-degree angled parking.
3. Sidewalk zone.
4. Conventional landscape island with trees.
5. Street frontage.
6. Building frontage.
7. Parking lot entry/egress.

KEVIN ROBERT PERRY

▲ *EXAMPLE: This parking lot treats its stormwater runoff within multiple stormwater swales throughout the site.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

NEVUE NGAN ASSOCIATES

▲ *EXISTING: A typical parking lot in San Mateo County.*

Parking Lot with Stormwater Planter Islands

This example shows a parking lot with stormwater planters replacing under-used parking stalls. This is one of the simplest parking lot retrofit actions to implement. The best approach is to convert the parking stalls immediately adjacent to a drain inlet. Depending upon the size and parking demand of a particular parking lot, a series of parking stalls may be consolidated into stormwater planters.

NEVUE NGAN ASSOCIATES

▲ *RETROFIT OPPORTUNITY: The same parking lot retrofitted with a stormwater planter. Notice that this stormwater planter is located near the existing drainage inlet.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Key Design Elements

1. Vegetated swale/planter accepts runoff from parking lot area.
2. 90-degree head-in parking.
3. Sidewalk zone.
4. Conventional landscape island with trees.
5. Street frontage.
6. Building frontage.
7. Parking lot entry/egress.

KEVIN ROBERT PERRY

▲ *EXAMPLE: This parking lot treats its stormwater runoff within multiple stormwater swales throughout the site.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Pervious Pavement for Internally Drained Parking Lots

This example shows a parking lot where stormwater drains inward towards the center of the parking drive aisles as opposed to sheet flow to the periphery of the site. Without redesigning the drainage system, the best, and most practical option is to utilize pervious pavement. The illustrated example below employs pervious pavement within the parking stalls and allows any excess stormwater runoff to drain into the existing storm inlet.

NEVUE NGAN ASSOCIATES

▲ *EXISTING: A typical parking lot in San Mateo County that directs stormwater runoff inward towards an area drain.*

NEVUE NGAN ASSOCIATES

▲ *RETROFIT OPPORTUNITY: The same parking lot retrofitted with pervious pavement in the parking stalls.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County

Key Design Elements

1. Pervious pavement within parking stall zone.
2. Concrete band separates paving material.
3. Sidewalk zone.
4. Conventional landscape with trees.
5. Street frontage.
6. Building frontage.
7. Parking lot entry/egress.
8. Drain inlet.

KEVIN ROBERT PERRY

▲ *EXAMPLE: This new parking lot utilizes pervious concrete within the parking lot's parking stalls.*

NEVUE NGAN ASSOCIATES

▲ *EXISTING: A typical large shopping mall parking lot in San Mateo County.*

Parking Lot with Center Median Vegetated Swale/Planter

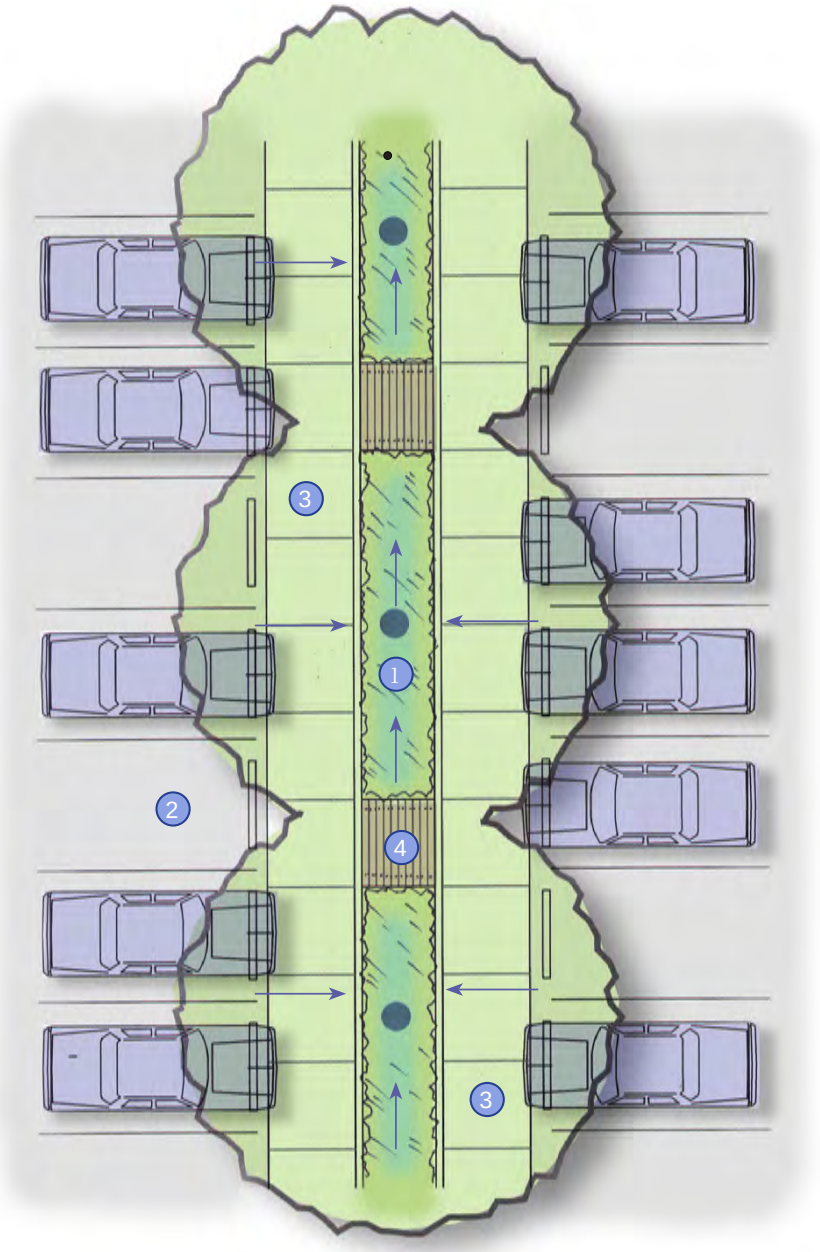
The example below shows the length of the parking stalls shortened in order to provide space for a vegetated swale or planter. This example also illustrates walkways in front of the parked cars and bridges that cross over the stormwater facility to connect these walkways. This design element allows people a refuge to walk to and from their destination without having to walk through a stormwater facility.

NEVUE NGAN ASSOCIATES

▲ *RETROFIT OPPORTUNITY: The same parking lot retrofitted with a stormwater planter/ vegetated swale. Notice the sidewalk zones and dedicated crossings to allow for adequate pedestrian circulation.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County



Key Design Elements

1. Vegetated swale/planter accepts runoff from parking lot area.
2. 90-degree head-in parking.
3. Pedestrian egress walkways
4. Stormwater bridges allow pedestrians to access their vehicles. These can be made of a variety of materials.

KEVIN ROBERT PERRY

▲ *EXAMPLE: This parking lot was retrofitted with a stormwater swale with several pedestrian crossings and ample space at the front of the parking zone to access the pedestrian crossings.*

NEVUE NGAN ASSOCIATES

▲ *EXISTING: A typical one-sided loaded parking lot in San Mateo County.*

Parking Lot with Green Gutters

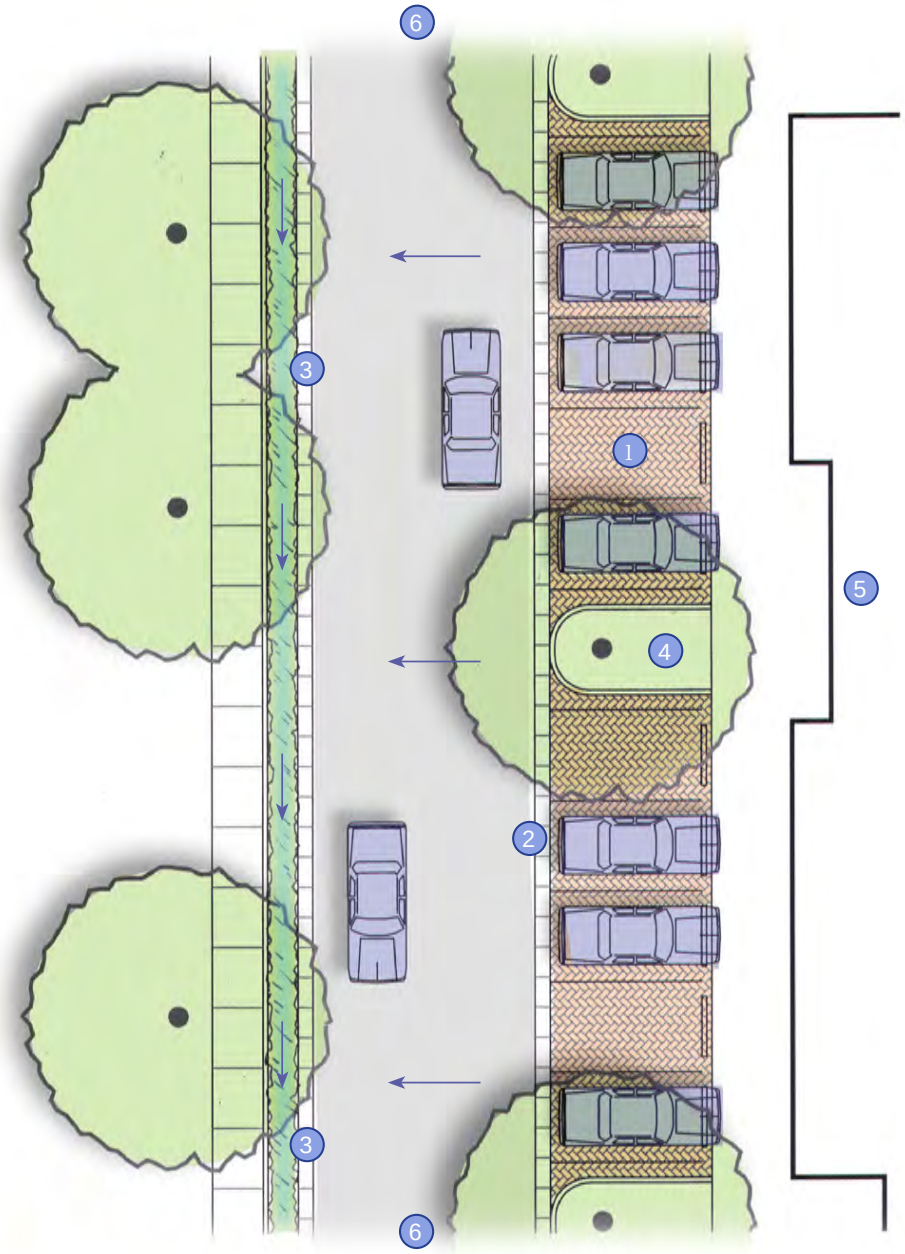
In some situations, a parking lot is only loaded with parking stalls on one side. This scenario lends itself to retrofitting a green gutter along the drive aisle side of the parking lot if the drainage flows in that direction. To better manage stormwater on-site, pervious pavement and a green gutter system are combined in the illustrated scenario below.

NEVUE NGAN ASSOCIATES

▲ *RETROFIT OPPORTUNITY: The same parking lot retrofitted with a green gutter and pervious paving in the parking stalls.*

3.3 Design Strategies and Guidelines

Buildings and Sites Design Examples for San Mateo County



Key Design Elements

1. Pervious pavement within parking stall zone.
2. Concrete band separates paving material.
3. Green gutter system.
4. Conventional landscape islands with trees.
5. Building frontage.
6. Parking lot entry/egress.

KEVIN ROBERT PERRY

▲ *EXAMPLE: A shallow green gutter accepts runoff from the adjacent parking lot surface.*