Ch 4: Site Design Strategies

This chapter provides supporting information regarding mandatory site design strategies

4.1 Introduction to Good Site Planning & Design

New development and redevelopment projects[1] that consider stormwater management early in the design process are more likely to achieve their mandatory Performance Requirements for less expense. Thoughtful site design may also reduce, and potentially eliminate, the need for expensive stormwater treatment controls later.

4.1.1 Planning Principals

Stormwater is an important natural resource that is critical for replenishing our streams, reservoirs, and groundwater supplies. To reduce water quality impacts of development project, consider implementing these fundamental principles:

- Preserve or minimize disturbance to natural features. Designs that integrate natural features of the project site are better at mimicking pre-development runoff characteristics (volume, rate, timing and pollutant loading) and minimizing the adverse impacts commonly associated with development. Additionally, there is value in maintaining corridors of natural habitat.

- Minimize the extent of impervious cover. Impervious cover is any surface on the site that cannot effectively absorb or infiltrate rainfall. It can increase runoff and the pollutants being carried by runoff, reduce groundwater recharge rates, and displace natural habitats.

- Disconnect impervious surfaces. Well-connected impervious surfaces are hydraulically efficient at removing runoff and associated pollutants in small rain events (and even heavy fogs). In contrast, designs that disconnect impervious surfaces provide an opportunity for small storm events to be intercepted and infiltrated.

4.1.2 Getting Started

This chapter provides insight behind the required design strategies. Many of the design strategies mentioned in this chapter start with a site assessment. The site assessment targets the optimal location for the development to occur within a given project site by identifying major site considerations (topography, existing structures, drainage features, trees, and soil types, etc.).

Oftentimes, it will be necessary to rely on a variety of disciplines to properly assess a site. Specific disciplines will vary based on the complexity of site but might include one or more of the following professionals: surveyors, engineers, landscape architects, biologists, geologist, and maybe even a geomorphologist.

The remainder of this chapter is intended to aid the designer in understanding some of the key elements to sustainable site design.

[1] "Redevelopment projects" are as defined in the Land Use Ordinance and Coastal Zone Land Use Ordinance. An example of a redevelopment project would be the creation or addition of at least 5,000 square feet of impervious area on a previously developed site.

4.2 Performance Requirement 1 Design Strategies

Performance Requirement 1 mandates that the following design strategies are employed for all projects:

- Limit disturbance of creeks and natural drainage features (4.2.1).
- Minimize compaction of highly permeable soils (4.2.2).
- Limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection (4.2.3).
- Minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state (4.2.4).

4.2.1 Limit disturbance of creeks and natural drainage areas

Everyone lives in a watershed. Each watershed is made up of many smaller sub-watersheds and many more even smaller catchment areas. Smaller catchment areas include ephemeral drainages which may not even appear 'creek' like, but if properly maintained can provide big benefits from a watershed perspective.

A well vegetated swale, or a historically 'wet' spot, can infiltrate and attenuate stormwater runoff, as well as filter pollutants. They can also provide greater diversity in the habitat.

Key Benefits

- Helps to preserve a site's natural hydrology and water balance
- Can act as a non-structural stormwater feature to promote additional filtration and infiltration
- Can help preserve a site's natural character, habitat and aesthetic appeal

Applicability
These procedures are suited for all sites adjacent to, or that contain, creeks and natural drainage areas including natural ponds, springs, vernal pools, marshes, wet meadows, swales and small channels. The principals apply whether the drainage area is considered perennial or ephemeral.

Limitations
None

Design Criteria

- Survey the site to delineate creek and natural drainage areas.
- To the extent possible, design the development around natural drainage features, and enhance these drainage features with native vegetation and a buffer area between them and the development.
- Require exclusionary fencing during construction to prevent inadvertent damage to these drainage resources.

Means of Demonstrating Compliance

Provide pre and post drainage features map on the Site Stormwater Assessment Exhibit in the Stormwater Control Plan (SWCP).

4.2.2 Minimize compaction of highly permeable soils

Undisturbed top soil has characteristics (texture, structure and biology) well suited for infiltration and water treatment. When soil is compacted or otherwise disturbed, it can lose its texture, structure and biology.

The soil on the left has pore spaces indicative of healthy soil that allows the efficient exchange of air and water. The soil on the right is compacted and will restrict root growth, and limit infiltration of air and water.

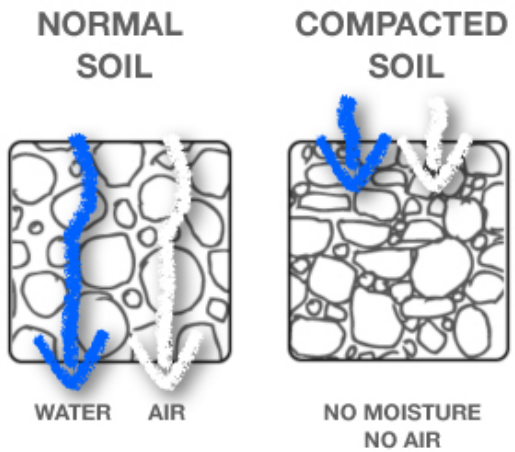


Figure 4.1 Normal versus Compact Soil
Source: http://www.landscaperesource.com/articles/introduction-soil-compaction-in-landscape.htm

Key Benefits

- Increases infiltration / decreases runoff
- Promotes healthy conditions for vegetation and soil biota

Applicability
These procedures are suited for sites where the development will not span the entire area.

Limitations
Even clay soils benefit from being protected from compaction, although the infiltration benefits are not as great as with non-clay soils.

Design Criteria

- To the extent possible, limit construction traffic to areas that will eventually be 'impervious'. This can be accomplished by delineating the soils to remain in place on the plans, and installing orange construction fencing around these areas to protect them from heavy equipment.
- Excavate and stockpile the top soil layer in areas requiring cuts. The stockpiled native top soil should be replaced on the surface of the area cut or used elsewhere on the site to amend areas with deficient topsoil. Stockpile

depths shall not exceed 3 feet if left in staging area for more than 6 months. Stockpiled top soil shall be spread onto cut slopes that have been tilled to a depth of 6 inches. The top soil shall be placed in lifts not exceeding 1 foot. Compaction should be limited to the density of existing, undisturbed areas.

Means of Demonstrating Compliance
Provide Site Stormwater Assessment Exhibit with soil types overlain with development footprint, including soil conservation areas. Designate the following:

- No disturbance areas,
- Areas that will required minimal disturbance
- Areas to be restored to (or mimic) the natural state (i.e. cut slope with native top soil or LID area) and
- Areas that are delineated for construction access and/or development footprint.

4.2.3 Limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection

Native vegetation provides numerous benefits, including providing sustenance for local wildlife. Additionally, native vegetation is well adapted to the local conditions and therefore requires less water and maintenance.

Key Benefits

- Reduces soil exposure (and resultant erosion and re-vegetation costs)
- Minimizes loss of native habitat and food source for native insects and animals

Applicability
These procedures are suited for sites that currently have native vegetation.

Limitations
Rural developments must adhere to Cal Fire/SLO County Fire Department “Road & Driveway Vegetation Clearance” and “Sample Site Plan” exhibits which may necessitate relocating planned features (road and structures) or extending clearance limits to adhere to the Cal Fire/SLO County Fire Department requirements.

Design Criteria
To the extent possible,

- Restrict clearing to that which is required to construct the project safely
- Cluster developments to minimize impacts to native vegetation
- Preserve native trees by protecting their root zones during construction.

Means of Demonstrating Compliance
Provide Site Stormwater Assessment Exhibit with native vegetation, overlain with development footprint.

4.2.4 Minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state

Development should be limited to site locations that avoid sensitive resource areas such as floodplains, steep slopes, erodible soils, wetlands, mature forests and critical habitat areas.

Buildings, roadways and parking areas should be planned on the least sensitive portions of the site to minimize impact, such as previously disturbed land which has been graded and/or compacted,

Key benefits

- Preserves the natural hydrology and drainage patterns of the site.
- Reduces grading impacts (including erosion and future stabilization)
- Reduces flood loss impacts
- Preserves riparian corridors

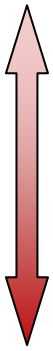
Applicability
Projects that do not consume the entire site.

Limitations
Sensitive resource areas on small sites can limit development options.

Design Criteria
Develop an exhibit showing location of sensitive resource areas on the site. Prioritize preservation of the resources. The following list provides a guideline for determining the least sensitive portion of the site, in order of increasing sensitivity:

Sensitivity Scale:

Low



High

1. Areas devoid of vegetation, including previously graded areas and agricultural fields.
2. Areas of non-native vegetation, disturbed habitats and Eucalyptus woodlands.
3. Areas of Chamise or mixed Chaparral, and non-native grasslands.
4. Areas containing coastal scrub communities.
5. All other upland communities.
6. Occupied habitat of sensitive species and all wetlands.
7. All areas necessary to maintain the viability of wildlife corridors.

Within each of the previous categories, areas containing hillsides should be considered more sensitive than the same category without hillsides.

In brief, concentrate or cluster development on the least environmentally sensitive portions of the site while leaving the remaining land in natural, undisturbed condition.

Means of Demonstrating Compliance
Provide Site Stormwater Assessment Exhibit with sensitive areas identified, overlain with development footprint. Include narrative in SWCP.

4.3 Performance Requirement 3 Design Strategies

Although the following design strategies are mandatory for projects subject to Performance Requirement 3, their implementation is encouraged for most projects. These strategies expand on Performance Requirement 2 considerations, including more specific consideration on placement of development:

> To determine the most suitable areas for development, you will also need to consider other constraints, such as visual, traffic, septic systems, easements, etc.
>
> To receive an overview of the process and a checklist of information and materials you will need to provide, schedule a **pre-application meeting** with County planning staff.

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas to be left undisturbed (4.3.1)
- Conserve natural areas, including existing trees, other vegetation, and soils (4.3.2)
- Limit the overall impervious footprint of the project (4.3.3)
    a. Clustering impervious areas
    b. Paving with permeable materials
    c. Shared parking agreements
    d. Street and sidewalk layout alternatives
- Construct streets, sidewalks, or parking lot aisles to the minimum widths necessary, provided that public safety or mobility uses are not compromised (4.3.4)
    a. Street widths
    b. Sidewalk widths
    c. Parking lot stall and aisle widths
- Set back development from creeks, wetlands, and riparian habitats (4.3.5)
- Conform the site layout along natural landforms (4.4.6)
- Avoid excessive grading and disturbance of vegetation and soils (4.3.7)

4.3.1 Define the development envelope and protected areas, identifying areas that are most suitable for development and areas to be left undisturbed

Most sites possess variability in topography, drainage patterns, soils types, etc. Some characteristics are more suitable for development than others.

The goal of this design strategy is to integrate the development project into the site rather than modifying the site to fit the development project. A site assessment will yield an opportunities and constraints map which can be used to help determine the most suitable location for the development to occur.

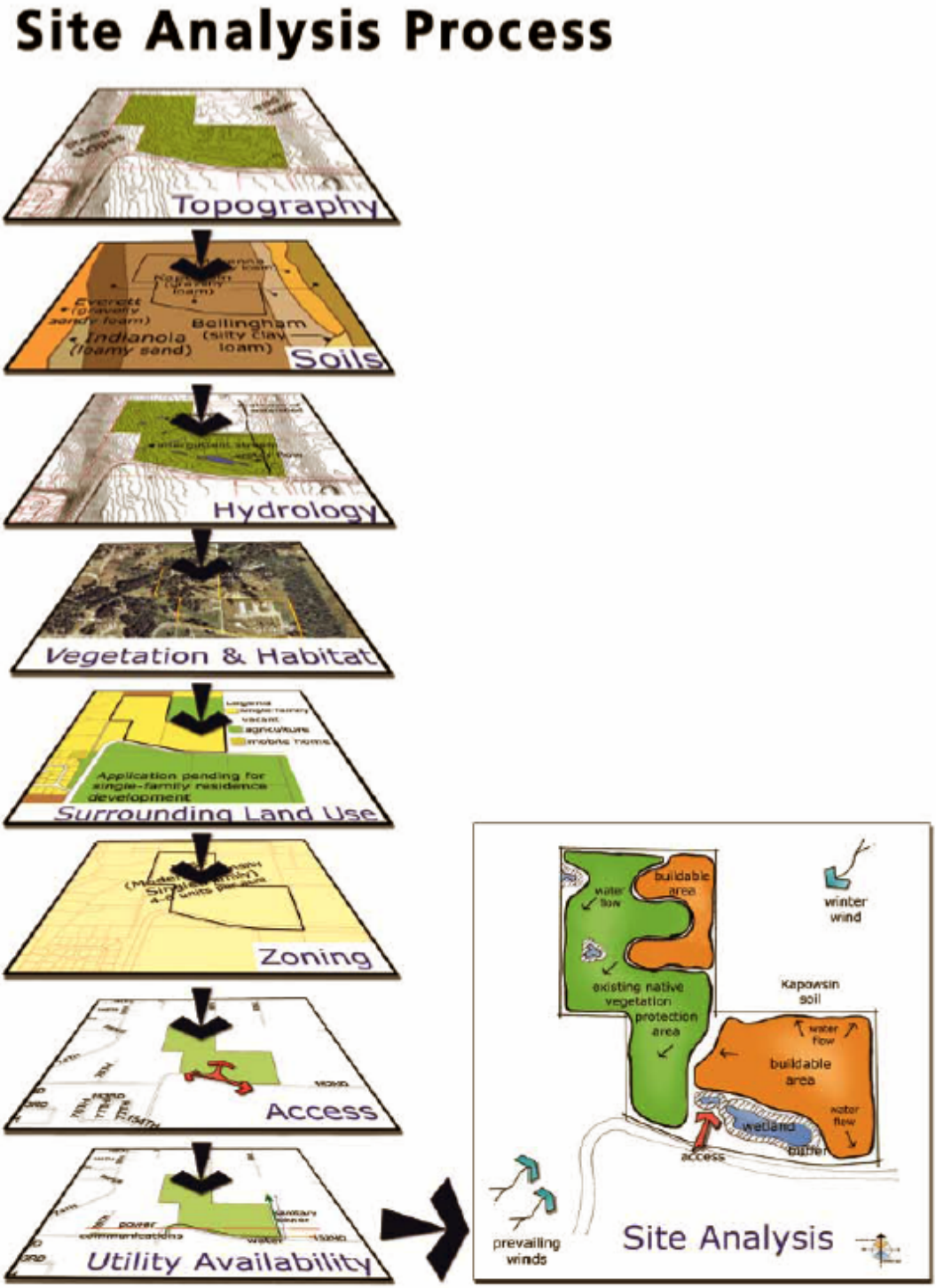


Figure 4.2 Site Analysis Process
Source Puget Sound LID Manual, graphic by AHBL Engineering

<u>Key Benefits</u>

- Reduces storm water impacts
- Preserves sensitive areas

Applicability
These procedures are most suitable for new development projects or projects seeking to expand.

Limitations
Redevelopment and in-fill projects may have limited opportunity to incorporate these recommendations.

Design Criteria
Inventory the environmental features of the site and adjacent properties to assess how the project will impact or be influenced by the surrounding areas. The analysis should consider both site and watershed-wide features, including:

___ Creeks, wetlands, watercourses, seeps, springs, ponds, lakes and areas within the 100-year floodplain. Consider existing drainage patterns, including locations of concentrated run-on and runoff.

___ Natural steep slopes, cliffs, outcrops, or other significant geologic features, as well as geotechnical hazard areas.

___ Tree conservation areas (include tree species, diameter at breast height, canopy cover and condition of ground cover and shrub layer).

___ Hydrologic soil groups and areas with high groundwater. Highlight the soils that provide the greatest opportunity for storage and partial infiltration.

___ Existing impervious surfaces, e.g., roofs, sidewalks, streets, and parking lots.

___ Evaluate average daily travel (ADT) volume of streets. Differentiate between those with lower volume (i.e. 15,000 ADT) and higher (i.e. 25,000 ADT)

___ Archeological and biological sensitive areas, including potential wildlife movement corridors (use terminology such as “Environmentally Sensitive Area”).

___ Existing fuel tanks (both on-site and within 500 feet of site).

___ Public and private wells and septic systems including leach lines (within 250 feet of the site).

Use the site information collected to locate the most suitable areas for development on the site constraints map.

Means of Demonstrating Compliance
Provide Site Stormwater Assessment Exhibit, overlain with development footprint.

4.3.2 Conserve natural areas, including existing trees, other vegetation, and soils

Natural areas generate the least amount of stormwater runoff and pollutant loads. From a stormwater standpoint, it is desirable to maintain as much of the site with natural vegetation and undisturbed soils as possible.

Key benefits

- Helps maintain the pre-development hydrology of a site by reducing runoff and promoting infiltration
- Native vegetation prevents erosion by stabilizing soil, filtering sediment and pollutants from runoff, and nutrient uptake
- Sites able to conserve undisturbed natural areas are able to minimize treatment requirements

Design Criteria.

- Identify and delineate natural areas present at the development site.
- Modify the layout of the development project to take advantage of natural features, preserve the most sensitive areas
- Buildings and roads should be located around the natural topography and drainage so as to avoid unnecessary disturbance of vegetation, soils and natural drainage ways.
- Provide exclusionary fencing during construction to prevent damage to tree roots and soils.

Means of Demonstrating Compliance
Provide Site Stormwater Assessment Exhibit with existing vegetation, overlain with development footprint.

4.3.3 Limit the overall impervious footprint of the project

There are numerous ways to limit the overall impervious footprint of the site. Four concepts are provided here:

1. Clustering impervious surfaces,
2. Using permeable surfaces in lieu of traditional impervious materials,
3. Implementing shared parking agreements with compatible adjacent property owners and
4. Adopting non-traditional street and sidewalk layout configurations. Other concepts, not discussed here, such as reducing building footprints, or increasing building density (number of stories above or below ground surface), should also be explored.

Include a narrative in the Stormwater Control Plan to minimally discuss the four concepts listed here, and how they were incorporated into the design, or the basis for rejection, if not adopted.

a. Clustering Impervious Surfaces

Clustering is the grouping of development structures within a project to allow a greater area to be preserved for open space, recreation or agriculture.

Key Benefits

- Maximizes open space, recreation and/or agriculture resources
- Encourages site planning sensitive to the natural characteristics of the land
- Helps reduce the effective impervious area associated with development
- Reduces required infrastructure

Applicability
Clustering may be used with nearly all development projects, but is most effectively used in the development of subdivision of larger parcels, where concentrating the allowable development on only a portion of the site allows preservation of sensitive resources. Incentives such as smaller lot size or bonus density increases, over that permitted in the zone, are often components of cluster development.

Limitations
Grading plans must comply with geotechnical engineering recommendations.

Design Criteria
Identify land to be protected: preserve areas within or adjacent to identified sensitive areas (steep slopes, wetlands, riparian corridors, etc.) or with high infiltration capacity.

- Run-on to preserved areas should mimic existing natural drainage patterns (i.e. if run-on formerly was conveyed to an area under sheet flow conditions, sheet flow conditions shall be maintained to the preserved area even after development of the surrounding area).
- Pre-development flow path lengths in natural drainage patterns are maintained, or lengthened as necessary to prevent an increase in runoff rates.

Locate site for potential development area. Include in the Stormwater Control Plan narrative, the preferred project density, and identify conflicts with code, if applicable.

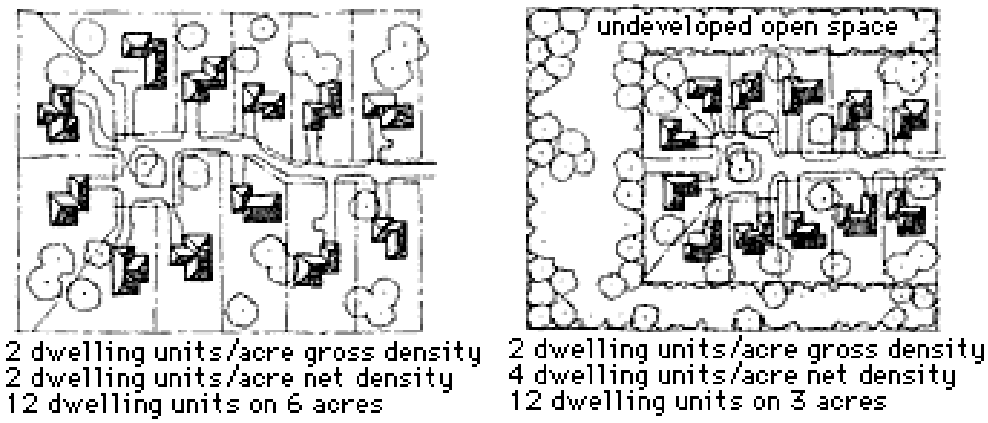


Figure 4.3 Clustering Impervious Surfaces
Source: City of Chesapeake, VA –Design Guidelines Handbook

b. Using permeable surfaces

Permeable surfaces allow water to percolate into the soil while serving as a structural surface. Permeable pavement surfaces may be used to replace traditionally impervious surfaces. Examples of materials that have increased permeability include unit pavers, granular materials, porous concrete or porous asphalt.

Key Benefits

- Allows for infiltration, reduces stormwater runoff volumes
- Facilitates groundwater recharge

Applicability
Parking lots, low traffic streets, walkways and driveways. Alternative parking surfaces are most effective in areas with native sandy soils. The ability of porous concrete and asphalt to exchange air and water makes it especially suitable for use around trees.

Limitations
Most suited for flat to gentle sloped areas, with light traffic and a low water table. The designer must certify that any porous surface proposed for use is able to provide adequate structural integrity for the intended purpose. These materials are not suitable for areas with a hard pan soils, high water table or in commercial/industrial areas of any soil type that have the potential for hazardous spills to occur on the parking surface. Development projects in areas with native clay soils require a subsurface drainage system.

Design Criteria
To the extent possible:

- Replace traditional impervious parking surfaces with an alternative pervious surface such as porous concrete, porous asphalt, permeable pavers, turf pave, etc. Pavers should have rigid edge systems to prevent movement of paving stones.
- Vegetate parking overhang areas or the area between the tire paths.

- Surface and stone recharge bed must be suitable for design traffic load.
- An underdrain is required for soils with limited infiltration rates.
- Terraced infiltration beds are required if porous concrete and asphalt are used on steep hills.
- Pre-treatment is advised in areas with high sediment loads.

c. Shared Parking Agreements

Shared Parking not only reduces impervious surface area, but also reduces parking related development cost and is intended to assure that the number and type of parking spaces specified does not exceed the number of parking spaces needed for the project.

Key benefits

- Reduces impervious area
- Reduces parking related development costs

Applicability

Parking alternatives are appropriate for adjacent developments with different peak demand periods and can be effective in compact and/or high density communities where dwelling units are within walking distance to transit stops and services.

Limitations

Reduction or elimination of off-street parking requirements for one neighborhood or commercial center may increase the parking density of adjacent neighborhoods or commercial centers. Shared parking agreements must include a contingency plan to accommodate changes in ownership, operations or other uses that might increase the parking demand in the future.

Figure 4.4 Shared Parking Agreements: Commercial parking lot for business closed on the weekends is opened on Sundays for additional church parking

Design Criteria

- Parking requirements should reflect projected demand for parking and include an analysis of the potential impact of spillover parking on adjacent areas.
- Minimize off-street parking to meet or decrease Title 22 and 23 parking ratios. If additional parking beyond the parking ratios is permitted, consider using pervious materials or storied parking garages.
- Maximize the use of compact car spaces.
- Use parking garages where feasible.

- Use pervious parking surfaces.
- Use legally binding shared parking agreements when adjacent proposed land uses have peak parking demands at different times of the day or week.
- Incorporate bioretention areas into parking lots.

d. Street and sidewalk layout alternatives

Subdivision street and sidewalk layout influences the amount of impervious area significantly. As shown below, the overall impervious area associated with streets is significant. Various street configurations can also influence the connectivity of a neighborhood and the land available for open space.

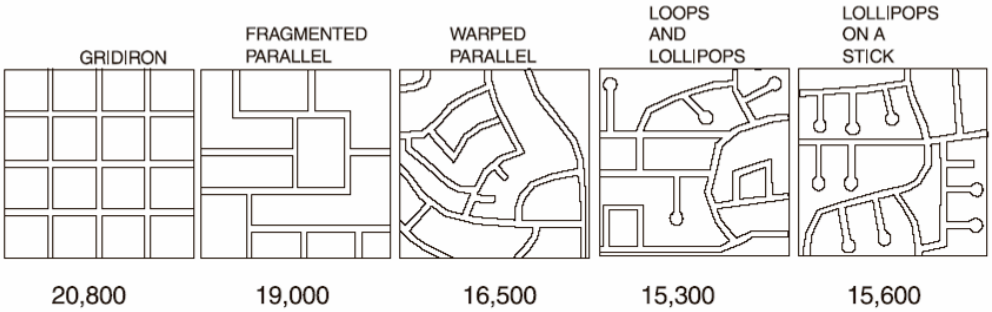


Figure 4.5 Comparison of linear feet of pavement associated with various street layout alternatives. (Source: NEMO LID Handbook, originally adapted from ULI 1980)

There are tradeoffs that must be evaluated between loss of connectivity and decreased impervious area. One option, in residential neighborhoods, balances the loss of car-focused connectivity with an increase of pedestrian-focused connectivity. The benefit of the later is that the green space provided for the pedestrian connectivity can be used to meet stormwater and open space goals. As shown in the City of Davis Bike Map, pedestrian and recreational facilities can also be used to meet stormwater and open space goals.

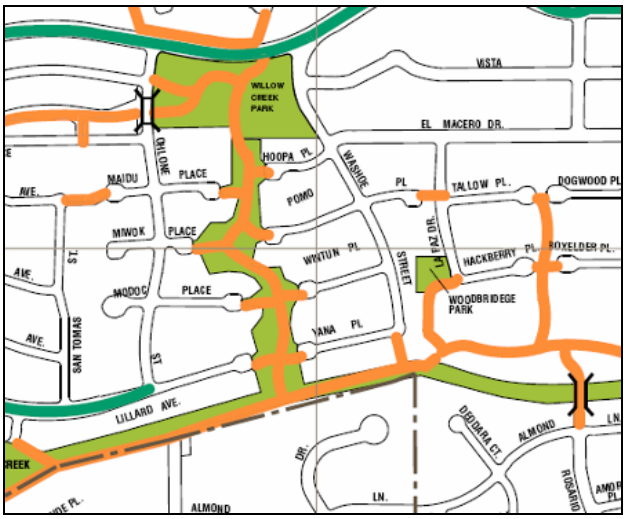


Figure 4.6 Optimizing Pedestrian and Recreational Facilities
Source: City of Davis Bike Map

Applicability
These procedures are suitable for all development projects, but must be weighed against other considerations, such as the amount of earthwork required, specific traffic patterns to the site and surrounding areas, as well as the design's impact to public safety.

Limitations
The roadway system must follow County Improvement Standards and safely accommodate all users of the road including pedestrians, people requiring mobility aids, bicyclists, drivers and passengers of transit vehicles, trucks, automobiles, and motorcycles. Requests to incorporate LID will require an exception in accordance with Section 1.2 "Design Adjustments" of the Public Improvement Standards. The minimum street widths for a particular project may be limited based on average traffic daily counts and/or terrain and size of vehicles requiring regular access to the site.

Design Criteria
To the extent possible,

- Provide pedestrian and bicycle path connections to encourage walking and cycling and increase access without adding significant impervious areas. Plot a likely "paths" exhibit using the lot layout to map pedestrian routes to schools, bus stop and neighborhood services.
- Reduce the length and width of residential streets by reviewing minimum lot widths and exploring alternative street layouts.
- Street location considerations should include natural drainage patterns and soil permeability and must provide for large vehicles, equipment, and emergency vehicles access where applicable.

See the Public Improvement Standard Plans for minimum street widths for public roads and adjustment procedures. Discuss options for reduced street widths with the applicable fire agency.

4.3.4 Construct streets, sidewalks, or parking lot aisles to the minimum widths necessary, provided that public safety or mobility uses are not compromised

Nearly all rainfall falling onto parking areas constructed of impervious surfaces (asphalt and concrete) will runoff the site. As runoff travels over the parking surface, it picks up sediment, dust, oils and greases. The smooth surface of the pavement increases the rate and volume of runoff.

Include a narrative in the Stormwater Control Plan to minimally discuss the concepts listed here, and how they were incorporated into the design, or the basis for rejection, if not adopted.

a. Minimize street widths

Excessively wide streets are a significant source of impervious cover (and stormwater runoff) in many residential developments. Narrower road sections and limiting street parking can reduce the amount of street width required to safely convey traffic.

Key Benefits

- Reduces impervious area (and resulting runoff)
- More room for trees and landscaping (improved aesthetics)

Applicability
Streets with low traffic volumes and adequate off-street parking facilities.

Limitations
The roadway system must follow County Improvement Standards and safely accommodate all users of the road including pedestrians, people requiring mobility aids, bicyclists, drivers and passengers of transit vehicles, trucks, automobiles, and motorcycles. Requests to incorporate LID will require an exception in accordance with Section 1.2 “Design Adjustments” of the Public Improvement Standards. The minimum street widths for a particular project may be limited based on average traffic daily counts and/or terrain and size of vehicles requiring regular access to the site.

Design Criteria
In addition to the criteria in section ‘Street & Sidewalk Layout Alternatives’ (4.3.3.b). design residential streets for minimum required pavement width needed to support travel lanes; on-street parking and emergency, maintenance and service vehicle access. These widths should be based on traffic volume.

To the extent possible, in addition to 4.3.3.b considerations,

- Minimize pavement by using alternative roadway layouts, restricting on-street parking, and minimizing cul-de-sac radii.

b. Minimize sidewalk widths

Sidewalk widths must comply with ADA regulations and should not be so narrow as to discourage walking. However, the impervious surface associated with sidewalks can be decreased, while still accommodating the comfortable use by the pedestrian.

Key benefit:

- Reduced impervious area
- More room for trees and landscaping (improved aesthetics)

Design Criteria
To the extent possible, in residential neighborhoods, eliminate the sidewalk from one side of the road and incorporate pervious surfaces (such as pervious concrete pavers for the sidewalk path that will remain.

c. Minimize parking lot stall and aisle widths

A minor reduction in parking stall and aisle dimensions can result in a significant impact on the overall size of a parking lot.

Key Benefit:

- Reduced impervious area
- More room for trees and landscaping (improved aesthetics)

Design Criteria

- Parking stalls and aisles should be reduced to the extent feasible in order to decrease total impervious cover.
- Consider implementing one-way aisles used in conjunction with angled parking to reduce the amount of aisle space needed to access each stall, depending on the geometry of the parking lot.
- Consider dedicating a portion of parking lots to compact car spaces. The most important element of a successful compact car parking space program is providing a clear system of signage that indicates which spaces are intended for compact cars and which are not.

4.3.5 Set back development from creeks, wetlands, and riparian habitats

A setback is a minimum distance between a natural resource (creek, wetland and/or riparian habitat) and the planned development.

Key Benefits

- Providing a canopy for reducing stream temperatures. Shade can keep creek waters cooler in summer months. Cooler water holds more oxygen and reduces stress on fish
- Supporting native wildlife habitat (if native vegetation is selected). Continuous stretches of riparian vegetation can also serve as wildlife corridors
- Diffusing raindrop velocities, and therefore reducing soil erosion
- Producing the necessary organic litter to support organisms
- Providing roots to hold bank soils in place
- Regulating stream flows. Riparian vegetation can slow the velocity of runoff and promote infiltration of stormwater into the soil
- Reducing pollutants and sediments in surface runoff being delivered to the creek.
- Providing room for flood flows and a buffer to development when creeks meander over time.

Riparian areas should be well vegetated with native plants. The ideal width of the vegetative buffer (or creek setback) varies throughout the County. Consult County Land Use Ordinance for specific requirements.

Applicability
These procedures are suited for all sites adjacent to creeks and natural drainage areas, including natural ponds, springs, vernal pools, marshes and wet meadows and apply whether or not the drainage area is present intermittently, or the creek is considered perennial or ephemeral.

Limitations
None

Design Criteria
Delineate the required setbacks on the plans, and in the field. The minimum setback is defined in the applicable regulations. The ideal setback is at the edge of the vegetated buffer, or the minimum setback, whichever is greater.

Within the Coastal Zone, the required setback from the upland extent of riparian vegetation is 100 feet. This setback is reduced to 50 feet within Urban Reserve Lines (URLs). Reductions to the riparian setback may only be approved as set forth in Section 23.07.174.d(2) of the Coastal Zone Land Use Ordinance.

To the extent possible,

- Ensure riparian areas are well vegetated with native plants
- Forecast where the creek hinge point will be if the bank soils are eroded (and consider the potential of creek meander over time). Provide a buffer from the future hinge point

Means of Demonstrating Compliance
Include a narrative of why setback(s) were chosen, and an exhibit showing resource and setback line. (Can be included in Site Stormwater Assessment Exhibit.)

4.3.6 Conform the site layout along natural landforms

Landform grading is a technique that converts “engineered” slopes to stable, naturally functioning slopes that mimic nature. Concave slopes allow water and vegetation to concentrate at flow lines. Grasses and groundcovers are planted on the convex portions of the slopes. Landform grading is intended to reduce erosion potential, runoff, and water quality degradation associated with land form alteration (grading).

Key Benefits

- Reduce erosion potential
- Reduce runoff
- Increase water quality

Applicability

Landform grading is suitable on all development projects that require significant cut and fill and where the average natural slope is ten percent or greater.

Limitations

Grading must be consistent with geotechnical engineering recommendations.

Design Criteria

The overall grading of the project should work together with the surrounding topography, existing vegetation, circulation, and land features as well as other elements of the total project site to minimize the erosion potential, runoff and water quality degradation associated with land form alteration (grading). Grading proposals should conform to the following standards:

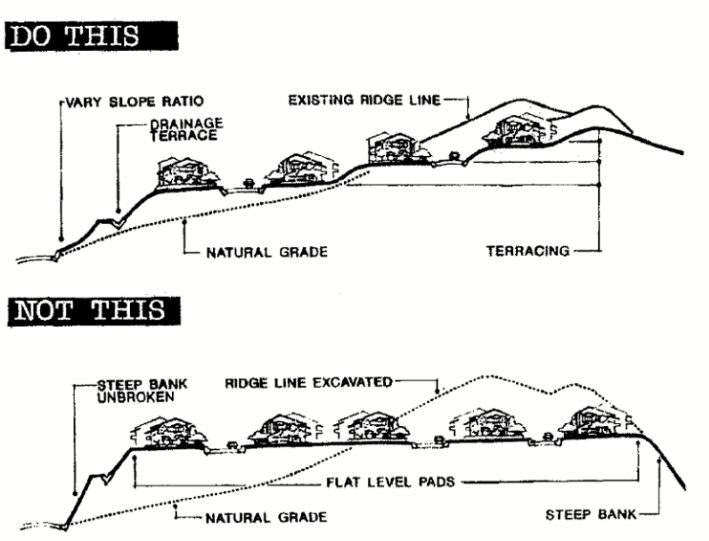


Figure 4.7 Landform Grading
Source: White County Sample Mountain and Hillside protection ordinance

- In lieu of one large pad, development proposed for hillsides should use smaller pads gradually terracing up hillsides, where feasible.
- The use of long, continuous slopes with sharp, angular forms should be avoided. Slopes should retain a natural appearance.
- Hillside development should conceal graded slopes and retaining walls, where possible. Retaining walls and all significantly graded slopes should be planted.
- Pads should not be built on compacted soil that is significantly raised above existing topography, unless no feasible alternatives exist given engineering constraints.
- Avoid creating directly connected impervious areas, where possible.
- Require compacted soils in areas receiving sheet flow runoff (such as yards, down slope of downspouts) be disked and amended with loam prior to planting.
- Ensure that concentrated flow paths have stable outlets able to handle the water expected to be received.
- Minimize building setbacks and road frontage criteria

Means of Demonstrating Compliance

Include a narrative discussion grading approach. Provide topography map with existing and planned contours, as well as cut and fill lines for the development. (Could be included in Drainage Management Areas (DMA) Exhibit.)

4.3.7 Avoid excessive grading and disturbance of vegetation and soils

Clearing and grading of the site should be limited to the minimum amount needed for the development to function.

Key Benefits

- Greater areas of a site that are preserved in their natural state retain their natural hydrology and may help buffer construction related erosion.
- Greater area can be used to preserve some of the hydrologic functions for a site. Building footprints can be minimized by using pillars, pin foundations, multiple stories, and stepped foundations.
- Reduced long term maintenance cost of site's landscaping
- Provides habitat and food for native species.

Applicability

These procedures are suitable on all development projects but are most easily applied on large lots in rural areas.

Limitations

In areas with heavy clay soils, there is significant runoff from undeveloped areas and the addition of impervious areas may not significantly increase the amount of runoff. Building height restrictions may limit allowable structure heights which lead to increased structural footprints.

Design Criteria

To the extent possible

- Design development 'up' and not 'out' to minimize construction area.
- Restrict clearing to minimum required for building footprints, construction access and safety setbacks.
- Implement phasing of grading operations to avoid mass grading of a site.

Means of Demonstrating Compliance

Include on Drainage Management Areas (DMA) Exhibit the planned disturbance areas, and construction fencing to set aside native areas to be preserved from construction equipment.

Ch 5: Site Design Measures

This chapter provides a guidance primer to assist applicants in integrating stormwater management and hydrologic goals and objectives into good site design.

5.1 Introduction to Site Design Measures

After implementing the design strategies discussed in Chapter 4, there are numerous other measures that can be taken to minimize stormwater–related issues on a site. This chapter focuses on other non-structural design measures.

Non-structural design measures contrast with structural design measures which require a device or facility to manage runoff (quality or quantity). Non-structural design measures can include source controls (such as nutrient and material management practices i.e. dog poop bags), and education outreach efforts ('drains to the bay' emblems, etc.). They can also be inherent in the site design (disconnecting impervious areas, retention grading, and tree planting).

Section 5.2 focuses on the mandatory site design measures associated with PR 1. Section 5.3 focuses on additional source control measures that should be considered for all projects (but are not mandatory).

5.2 Performance Requirement 1 Mandatory Design Measures

All projects must implement at least <u>one</u> of the following site design measures:

- Roof runoff directed into cisterns or rain barrels for reuse (5.2.1)
- Roof runoff directed into vegetated areas (5.2.2)
- Runoff from sidewalks, walkways, and/or patios directed onto vegetated areas (5.2.3)
- Runoff from driveways and/or uncovered parking lots onto vegetated areas (5.2.4)
- Bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios constructed with permeable surfaces (5.2.5)

Techniques to disconnect impervious area, in addition to the items above, are provided in Section 5.2.6.

5.2.1 Cisterns/Rain Barrels

Approximately 40 percent of all urban water use is for irrigation. Capturing and later reusing rainwater in water barrels or cisterns reduces the volume of runoff during rain events and conserves potable water supplies. Roof runoff contains no chlorine or hard minerals. It can easily be used later for landscape irrigation purposes or as collected water conveyed to typical graywater usages (i.e. flushing toilets).

In arid areas with heavy rainfall events, large cisterns are necessary if the goal is to capture entire rain events. For instance (as seen in the calculation below), a house in the City of San Luis Obispo subject to a 1 inch storm (0.083 ft), with a total roof area of 1000 square feet could yield 620.8 gallons of water for that storm event alone.

Supply in Gallons

= Roof Area directed to rain barrel x rain event, depth (ft) x 7.48 gallons/cf

= 1000 sf x 0.083 ft x 7.48 gallons/cf

= 620.8 gallons produced

That's enough water to meet the daily domestic needs of more than seven average Americans for one day. Capturing the average annual runoff in the above example could yield over 12,000 gallons of water.

However to completely capture an entire 1 inch rain event, a total of twelve 55 gallon barrels would be needed (assuming that no draw was being taken from the barrel during the rain event and roof rain was lost to evaporation).

Number of 55 gallon barrels needed = 620.8 gallons / 55 gallons per barrel
= 11.3 barrels
= 12 barrels

The equation below can be used to calculate the storm that would fill up a single 55 gallon barrel:

$$\text{The depth of rain that will fill a barrel} = \frac{\text{Capacity of rain barrel (gallons)}}{\text{Contributing roof area (sf)} \times 7.48 \text{ gallons/sf (conversion factor)}}$$

$$= \frac{55 \text{ gallons}}{1000 \text{ sf}/4 \times 7.48 \text{ gallons/sf}}$$

$$= 0.03 \text{ inches of rain}$$

Rain barrels can come in all shapes and sizes. For the committed rainwater harvester, a large underground tank (equipped with pumps) may be more suitable (but more costly) than an above ground tank.

Key Benefits

- Reduces runoff volumes and peak rate
- No maintenance verification requirement
- Water stored can be reused, reducing water supply demand

Applicability

The volume of roof runoff to be intercepted is directly proportional to the area of the roof. A larger roof yields more runoff.

Limitations

Roofs constructed with tar, gravel, treated cedar shakes or old asbestos shingle roofs may create too much contamination for rainwater harvesting. Similarly,

rainwater should not be harvested if it is conveyed via gutters with lead soldering or lead-based paints. Runoff from roofs exposed to air borne particles originating from cement kilns, gravel quarries, crop dusting, or concentrated automobile emissions could adversely affect the rainwater quality.

Low storage capacities will limit rainwater harvesting so that the system may not be able to provide water in a low rainfall period. Increased storage capacities add to construction and operating costs and the room necessary to accommodate storage needs.

Design Criteria

- Sizing of cisterns and rain barrels should be based on roof area, rainfall patterns, anticipated water usage of connected plumbing facilities or landscape water needs.
- Rainwater collected and intended for flushing toilets will require a parallel plumbing system (aka graywater). See the latest California Plumbing Code (Chapters 16 & 17) for direction.
- Rainwater collected and intended for potable uses should include filtration and disinfection to eliminate potential contamination originating from leaves, bird droppings, dust, and other natural causes.
- Tanks should be securely covered with fine-mesh screens on all inlet and outlet pipes to keep mosquitoes and debris from entering tanks. This also protects the tanks from inadvertently trapping and drowning children and wild or domestic animals.
- Tanks should be located on stable, flat ground.
- Rain cisterns and rain barrels should be equipped with overflow devices able to convey spills away from any adjacent structures. Verify that the overflow device is adequately sized to convey the anticipated rain events it will be subject to.
- Consider installing a “first flush” diverter to increase stored water quality and reduce tank maintenance needs. The first flush diverter should allow the first 10 minutes of a storm event after a long dry period to bypass the system. Consider employing one of the various above or below ground ‘diverter kits’ out on the market appropriate for the tank chosen.)

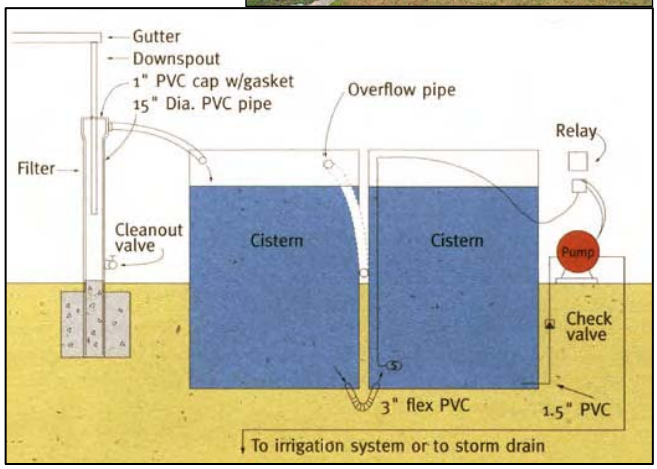


Figure 5.1 Rainwater Harvesting

Source: TreePeople, *Rainwater as a Resource: A Report on Three Sites Demonstrating Sustainable Stormwater Management*, 2007. (Picture above from http://www.lid-stormwater.net/images/cistern4.jpg)

5.2.2 Roof runoff directed into vegetated areas

When rooftop runoff is "disconnected" and directed to an area where it can infiltrate the soil or flow over a pervious area such as a planted area or a swale with sufficient time and velocity to allow for filtering, the adverse impact of the impervious roof can be mitigated.

Key Benefits

- Reduces runoff volumes and peak rate
- Promotes infiltration
- No maintenance verification requirement

Limitations
Requires area for infiltration. Works best with Hydrologic Soil Groups A and B.

Design Criteria

- Grade and compact surfaces adjacent to the structure so that runoff flows away from foundations.
- Limit the contributing rooftop to 75 feet or less. The length of the flow path over the pervious area should be equal to or greater than the contributing rooftop length.
- The rooftop contributing area to any one discharge location should not exceed 1,000 sf and the receiving slope should be less than or equal to 5%, and be well vegetated.
- The maximum ratio is 2 parts impervious area for every 1 part pervious area.

Figure 5.3 Roof scuppers are used to direct runoff through planters.
This practice reduces the overall volume of runoff leaving the site during small storms.
Source: www.tualatinriverkeepers.org

5.2.3 Runoff from sidewalks, walkways, and/or patios directed onto vegetated areas

When runoff from impervious sidewalks, walkways and/or patios is "disconnected" and directed to an area where it can infiltrate the soil or flow over a pervious area such as a planted area or a swale with sufficient time and velocity to allow for filtering, the adverse impact of the impervious surface can be mitigated.

Key Benefits

- Reduces runoff volumes and peak rate
- No maintenance verification requirement

Applicability
Impervious sidewalks, walkways, and/or patios

Limitations
Requires area for infiltration. Works best with Hydrologic Soil Groups A and B. Do not discharge runoff originating from 'hotspot' (contaminated) surfaces into vegetated areas.

Design Criteria

- Ideally, limit the contributing impervious flow path to 75 feet or less.
- The length of the flow path over the pervious area should be equal to or greater than the contributing length. Generally, the vegetated area should be no less than half of the impervious area that drains to it.
- The disconnection must drain continuously through a vegetated channel, swale, or filter strip to the property line or a stormwater treatment practice.

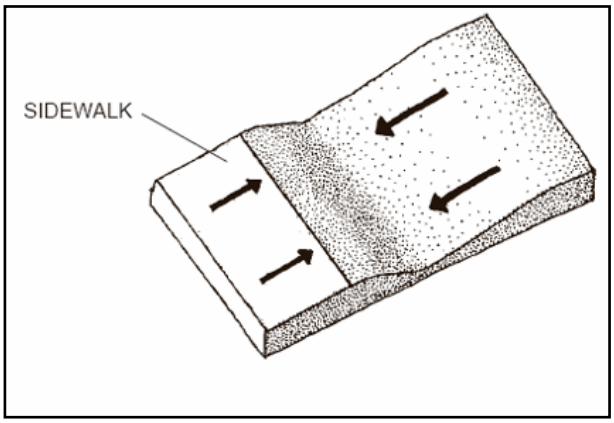


Figure 5.4 Sidewalk Runoff Directed to LandscapingSource: dot.tucsonaz.gov/stormwater/downloads/2006WaterHarvesting.pdf

- The receiving slope should be less than or equal to 5%, and be well vegetated.
- The maximum ratio is 2 parts impervious area for every 1 part pervious area.

5.2.4 Runoff from driveways and/or uncovered parking lots onto vegetated areas

When runoff from impervious driveways and/or uncovered parking lots is "disconnected" and directed to an area where it can infiltrate the soil or flow over a pervious area such as a planted area or a swale with sufficient time and velocity to allow for filtering, the adverse impact of the impervious surface can be mitigated.

Key Benefits

- Reduces runoff volumes and peak rate
- No maintenance verification requirement

Applicability
Impervious driveways and/or uncovered parking lots.

Limitations
Requires area for infiltration. Works best with Hydrologic Soil Groups A and B. Do not discharge runoff originating from 'hotspot' (contaminated) surfaces into vegetated areas.

Design Criteria

- Ideally, limit the contributing impervious flow path to 75 feet or less.

- The length of the flow path over the previous area should be equal to or greater than the contributing length. Generally, the vegetated area should be no less than half of the impervious area that drains to it.
- The disconnection must drain continuously through a vegetated channel, swale, or filter strip to the property line or a stormwater treatment practice.
- The receiving slope should be less than or equal to 5%, and be well vegetated.
- Concentrated flows should be transformed to sheet flows using level spreaders, or energy dissipation techniques.

5.2.5 Bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios constructed with permeable surfaces

A significant portion of impervious cover in an urban watershed is derived from parking lots and roadways. Substituting traditional impermeable surfaces (concrete, asphalt) with permeable surfaces (unit pavers, pervious concrete, etc.) can significantly reduce the volume of runoff generated from a site.

Key Benefits

- Reduces or eliminates stormwater runoff
- Reduces downstream flooding
- Promotes infiltration
- No maintenance verification requirement
- Alternative materials can help distinguish parking and bike lanes from travel ways

Figure 5.5 Porous Concrete Parking Lot
Porous concrete was used in lieu of traditional asphalt to protect the oak tree adjacent to the parking lot.
Source: Wallace Group.

Applicability
Impervious overflow parking areas, bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios.
The ability of porous concrete and asphalt to exchange air and water makes it especially suitable for use around trees.

Limitations
Generally not appropriate for high traffic or heavy vehicle load areas, or located on steep slopes. May be cost prohibitive in areas without well-draining soils. These materials are not suitable for areas with a hard pan soils, high water table or in commercial/industrial areas of any soil type that have the potential for hazardous spills to occur on the parking surface.

Design Criteria

- Run-on is free of deleterious materials, such as sediment or pollutants.
- Explore the use of the following materials (partial list!) in lieu of asphalt and concrete:
  - Porous asphalt
  - Pervious concrete
  - Reinforced turf
  - Unit pavers
  - Aqua Bric (has same structural coefficient as asphalt)
  - Permapave
  - Net pave
  - Checker Blocks
  - Turfstone
- Evaluate alternative products for their Open Area Percentage and ability to comply with ADA regulations.
- Site should be relatively flat
- Infiltration based permeable systems should be placed a minimum of 5 feet down-gradient, or 50 feet up-gradient of building foundations and/or property lines.
- Provide an overflow edge or pathway to an intended stabilized location (storm drain or well-vegetated area).
- The designer must certify that any porous surface proposed for use is able to provide adequate structural integrity for the intended purpose.

5.2.6 Disconnecting Impervious Area Techniques

Runoff from an impervious area to a pervious area must be conveyed in a manner that is non-erosive. This section contains additional techniques to disconnecting impervious areas.

Key Benefits
Reduces or eliminates stormwater runoff

a. Curb and Gutter Alternatives, including Curb Cuts

Curb, gutters and catch basin inlet systems are highly discouraged for use as stormwater collection systems because they concentrate flows and pollutants, increase velocities and discourage groundwater recharge.

Applicability
Alternatives to curb and gutter are encouraged in parking lots and in low- and medium-density residential zones where soils and slopes permit.

Limitations
Drainage inlets may be more appropriate in localized areas subject to frequent flooding during minor rain events. Curb and gutter systems may be required in urban settings, or where a new road must tie into an existing collector road. Additionally,

where high-speed traffic and pedestrian use occur in the same vicinity, a curb and gutter system may be necessary to provide distinct area for each use.

Design Criteria

- Where curb and gutters have been designated as a means of separation between pedestrians and motorized traffic, consider the following hybrid LID/conventional stormwater management approaches:
  - The ability to place a vegetated channel between the sidewalk and the roadway.
  - The potential to incorporate a two-foot wide concrete strip constructed along the edge of the pavement at the same surface elevation of the pavement. This concrete strip gives drivers a visual cue of the edge of the driving surface and helps protect the vegetated channel from tire ruts.
  - Implementing a curb and gutter system on one side of the road and allowing the road to drain to the other side of the road (road will have super-elevation instead of crowned section).
- Where curb and gutter systems are required for drainage purposes, curb cuts can be spaced strategically to allow runoff to be intercepted into a surface feature (such as a planter or sand filter) where there is an opportunity to infiltrate runoff instead of conveying it directly to a subsurface drainage network. The frequency of curb cut openings is determined to minimize the spread width of stormwater on the road during primary storm events or to keep the volume and velocity of discharge passing through the curb cut from being erosive in the vegetated swale.
- Parking lots that incorporate sumped vegetation areas can use wheel stops in lieu of curb systems to protect the vegetated area from traffic intrusion while allowing parking lot runoff to be drained into the vegetation.
- The design shall provide an emergency overflow path.

b. Intercept drains

Impervious areas that drain into the stormwater system are considered "connected impervious areas." These areas can be "disconnected" by directing the runoff to a landscaped area instead. Traditionally "connected" impervious areas well suited for "disconnection" include roof tops, parking lots and driveways.

Applicability

These procedures are suitable on all development projects including redevelopment.

Figure 5.7 Intercepting Driveway Runoff
Directing driveway runoff into a vegetated area by intercepting it with a trench drain is one way to reduce the volume of runoff leaving the site during small storms.
Source: Unknown

Limitations
Runoff must be discharged at locations that will flow away from structures, have adequate area available to receive the runoff, and are sloped to avoid erosion.

Design Criteria
To the extent possible,

- Roofing downspouts should be redirected to a yard, garden or swale or replaced with drip chains or scuppers.
- Runoff from driveways should not drain directly to a road; instead driveways should:
- Be constructed from pervious materials, or
- Be sloped to drain onto stabilized groundcover area, or
- Be designed to intercept and drain runoff in dispersion trench to adjacent vegetated area.
- Sidewalks and street runoff should drain to stabilized groundcover areas.

5.3 Source Control Measures

Source control refers to any schedules of activities, prohibitions of practices, maintenance procedures, managerial practices or operational practices that prevent stormwater pollution by reducing the potential for contamination at the source of pollution.

Source control measures are required for all projects. Source control measures can be categorized as Structural, Procedural or Operational.

> Structural source control measures are physical measures employed to prevent stormwater from contacting work and storage areas to prevent stormwater from picking up pollutants.
>
> Operational source control BMPs are non-structural practices such as employee training, record keeping, good housekeeping, preventative maintenance, spill prevention and cleanup.
>
> Procedural source controls BMPs include implementing process changes such as substituting a less hazardous material for a highly hazardous material in an industrial process.

Implementing operational and procedural source control BMPs are generally considered more cost-effective in minimizing pollution than structural source control measures. Operational and procedural source controls are addressed in Chapter 8 “Operation and Maintenance” of this handbook.

While some source control measures can be broadly applied to development, others are site and pollutant specific. This chapter describes the purpose, design criteria, maintenance requirements and appropriate use of structural source control measures approved for use in the unincorporated areas of San Luis Obispo County.

The following source control measures are discussed in this section.

- Storm Drain Markers (5.3.1)
- Efficient Irrigation (5.3.2)
- Trash & recycling storage areas (5.3.3)
- Vehicle and Equipment wash areas (5.3.4)
- Material storage areas (5.3.5)
- Mutt Mitt Stations (5.3.6)
- Alternative Building Materials (5.3.7)
- Interceptor Trees (5.3.8)

5.3.1 Storm Drain Markers

Storm drain markers are highly visible source controls that are placed adjacent to storm drain inlets. This measure informs the public that runoff drains directly to water bodies. Storm drain markers raise awareness to help deter littering and illegal dumping.

Key Benefits
Raise awareness

Applicability
Storm drain marking procedures are suitable for storm drain inlets with concrete curb and gutters.

Design Criteria
All new storm drain inlets shall be provided with a marker as specified by the County Public Improvement Standards.

Figure 5.8 Storm Drain Markers
Source: Unknown

5.3.2 Efficient Irrigation

Efficient irrigation techniques minimize waste and reduce the amount of dry weather runoff discharged to the storm drain system. Efficient irrigation techniques include rain and wind-triggered shutoff devices, automatic line break detection shutoff valves and soil moisture sensors.

Key Benefits

- Minimize water use
- Preserves structural integrity of adjacent hardscapes

Applicability
Efficient irrigation is suitable for all development with irrigated areas.

Limitations
None

Design Criteria
To the extent possible, install

- Native plants that require minimum irrigation.
- Underground or surface drip irrigation
- "Smart" Irrigation controllers with evapotranspiration, high wind, and rainfall sensors to prevent over- and under-watering and watering during rainfall events and/or with programmable schedules to set watering time and duration according to plant and seasonal needs. These controllers can also detect and shut off water when the sensor indicates an out of expected flow rate.

Figure 5.9 Poor Example of Efficient Irrigation

5.3.3 Trash/Recycling Storage Areas

The trash and recycling storage area refers to an area where trash and/or recycling receptacles (dumpsters) are located for use as a repository for solid wastes. Loose trash and debris can easily be transported by the forces of water or wind into nearby storm drain inlets, channel, and/or creeks.

Key Benefits

- Minimizes risk of loose debris
- Reduces risk of contaminating stormwater runoff

Applicability
These procedures are suitable for all multi-family residential units with four or more units, commercial projects, and industrial trash areas. Single family residences are exempt from these requirements.

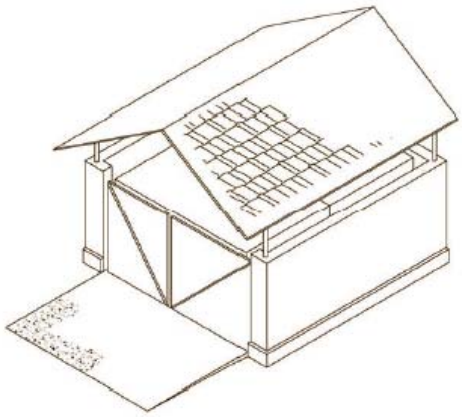


Figure 5.10 Trash/Recycling Storage Area protected from wind and rain

Design Criteria

- Project design should provide an appropriate number of adequately sized receptacles.
- Trash and recycling storage areas must divert drainage from adjoining roofs and pavements around the area(s). Project plans should show how the container

area will be graded and paved to prevent run-on into the area and to prevent runoff from leaving the area.

- Trash and recycling storage container areas must be screened or walled to prevent offsite transport of trash.
- Trash and recycling storage within containers should be secured to prevent loose trash and debris from being dispersed by the wind.
- Uncovered bins should be roofed to prevent rainwater from co-mingling with the bin's contents.
- Trash and recycling storage enclosure pads should be designed to drain to a pervious surface through indirect soil infiltration or to an appropriate treatment control BMP prior to connection to a sanitary sewer.
- The proposed enclosure detail shall be submitted to the County and contracted recycling and garbage hauler for review and approval. Before a building permit can be issued, a form from each hauler accepting the relevant container location and enclosure detail must be submitted.
- No connection to the storm drain system is allowed for new facilities.

5.3.4 Vehicle and Equipment Wash Areas

Vehicle and equipment wash waters commonly contain high concentrations of sediments, oils and grease, cleaning chemicals, phosphates, antifreeze and heavy metals. These materials are prohibited from entering the storm drain system through the illicit discharge detection elimination ordinance.

Key Benefits

- Minimizes risk of loose debris
- Reduced non-storm water runoff

Applicability

These procedures are suitable for all multi-family residential, commercial and industrial areas.

Design Criteria

Describe measures taken to discourage onsite vehicle and equipment washing and explain how these will comply with the appropriate design criteria provided below for commercial/industrial, restaurant, and residential applications.

Commercial/industrial applications:

- Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.
- Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system.
- Wastewater from the commercial vehicle and equipment wash areas shall be equipped with (at a minimum) a clarifier, or other pretreatment facility, and

properly connected to the sanitary sewer, or other appropriately permitted disposal facility. Vehicle wash water should only be discharged to the sanitary sewer and only after obtaining permission from the local wastewater treatment authority.

- Fueling and maintenance activities shall be isolated from vehicle and equipment wash areas.
- Secondary containment shall be provided for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment area.
- Tanks, containers or sinks used for parts cleaning or rinsing shall not be connected to the storm drain system and may only be connected to the sanitary sewer system. These connections may require additional approvals and permits.

Residential application:

- Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited onsite and hoses are provided with an automatic shutoff to discourage such use).
- Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area. Large common areas shall be plumbed to drain to the sanitary sewer.

Restaurant application:

- Collect grease in containers and contact a licensed recycling company to haul them away. The grease will be recycled into useful products like soaps, animal feed, or bio-diesel fuel.
- Food service facilities, including restaurants and grocery stores shall have a sink or other area for cleaning floor mats, containers and equipment. The cleaning area must be located over a paved area and have secondary containment. It must be large enough to clean the largest mat or piece of equipment that needs cleaning. The sink or cleaning area shall be connected to a grease interceptor prior to discharge to the sanitary sewer system.

5.3.5 Material Storage Areas

Outdoor material storage areas include areas or facilities designated solely for storage of materials. Improper storage of materials outdoors may provide an opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the storm drain system.

Proper storage is necessary to prevent materials being stored outside from being washed away in stormwater runoff, spilled, or inadvertently discharged to the storm drain system.

<u>Key Benefits</u>

- Minimizes risk of loose debris

- Minimizes potential for groundwater pollutants
- Minimize risk of contaminating stormwater runoff

Applicability

These procedures are suitable for all projects that include outdoor storage areas for materials. Sites with large quantities or liquids or bulk materials at sites that are connected to the storm drain system are at greatest risk, including:

- Nurseries and garden centers
- Auto recyclers/body shops
- Building supply outlets
- Landfills and recycling centers
- Solid waste and composting facilities

Design Criteria

- Store materials indoors, if feasible.
- Infiltration is discouraged in outdoor material storage areas.
- Protect materials stored outside from rainfall and wind dispersal by keeping them in an enclosure such as a cabinet or shed.
- Protect materials stored outside from run-on by constructing a secondary containment structures (such as berms, dikes or curbs) around the perimeter of the storage area.
- Provide an area to pool spills for collection and disposal or, if allowed, pre-treat and drain the area to the sanitary sewer system. If required, obtain an Industrial Waste Discharge Permit. Secondary containment areas should be sized to hold 110% of the volume of the storage tank or container unless other containment sizing regulations apply (e.g. fire codes).
- Store materials on paved or impervious surfaces.
- Exterior storage areas shall be covered with a roof or awning to minimize collection of stormwater within the secondary containment area.
- Hazardous materials signage, if applicable.

5.3.6 Pet Mitt Stations

Pet waste is a known contributor to stormwater pollution. Providing pet mitt stations at locations that are attractive to dog owners can encourage owners to pick up pet waste.

Key Benefits

Reduces nutrient load conveyed to surface and groundwater

Figure 5.11 Pet Waste Station, Morro Bay

Applicability
These procedures are suitable for all properties with large, accessible open areas.

Design Criteria
Pet mitt stations should consist of a dispenser with biodegradable bags for scooping pet waste and informational signage.

5.3.7 Alternative Building Materials

Some building materials, such as copper, are prone to leach toxic compounds into stormwater runoff. Some building materials require the routine use of pollutants (i.e. toxic paints and finishes) to maintain their integrity. This BMP employs alternative materials that are not prone to leach toxic compounds or require toxic compounds to maintain their integrity.

Key Benefits
Minimizes risk of contaminating runoff

Applicability
Alternative building materials are suitable for all developments.

Design Criteria

- Consider using building materials that incorporate green technology, use less toxic materials in their manufacturer, or require minimum maintenance.
- Avoid roofing, gutters, and trim made of copper or other unprotected metals that could leach into runoff.

5.3.8 Interceptor Trees

Trees are effective in intercepting light storm events by temporarily capturing, storing and evaporating rain water from their leaves, branches and trunk bark.

Key Benefits

- Reduced runoff
- Increased absorption

Applicability
Interceptor trees are well suited for parking lots and can be incorporated into a project's landscaped areas.

Limitations
Trees should not be planted where they will interfere with utility lines (both surface and subsurface facilities) or create a fire hazard. Certain trees should not be used as their roots are known to damage adjacent impervious hardscapes. Consider the potential impacts of tree shade on adjacent structures and landscaping.

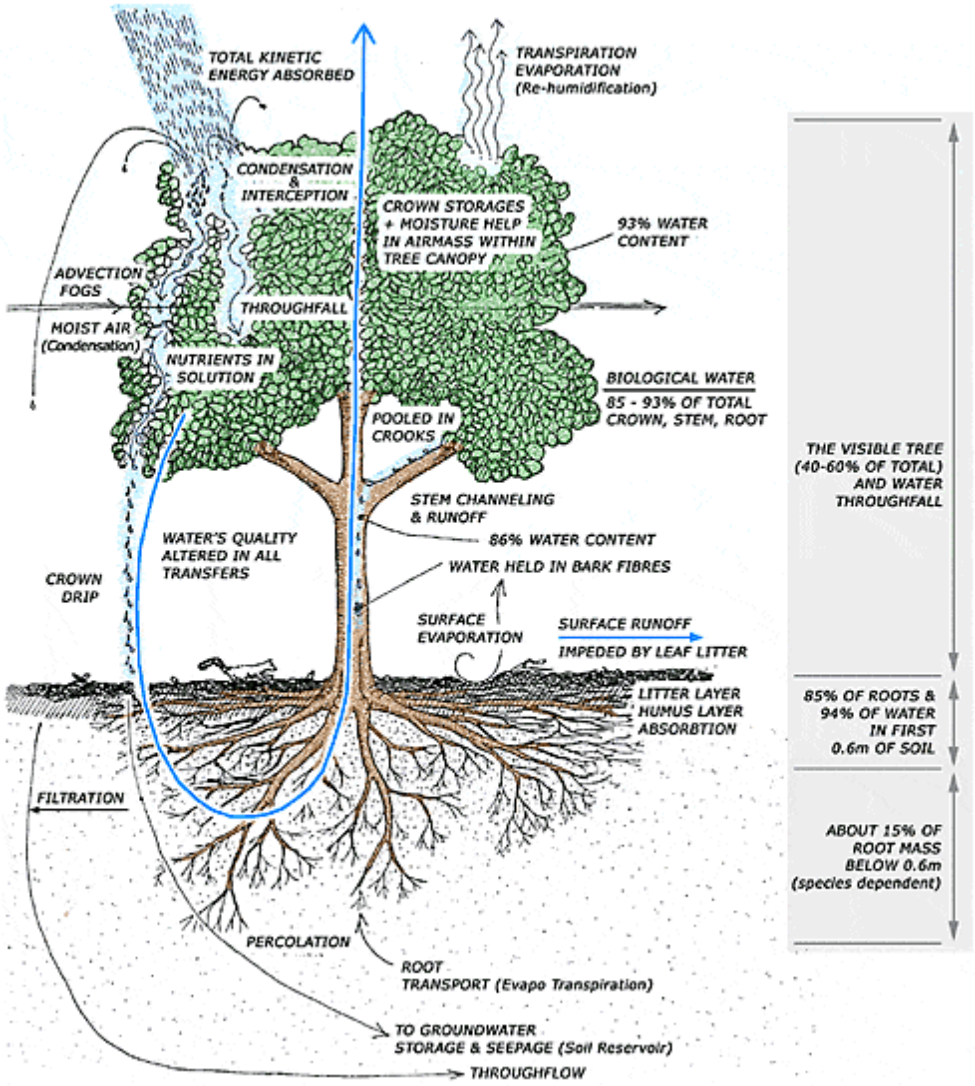


Figure 5.12 Interceptor Trees
Source: http://www.water-sos.org/sketches/trees-500pix.gif

<u>Design Criteria</u>

Broadleaf evergreens and conifers intercept more rainfall than deciduous species. Trees that grow well in winter in San Luis Obispo County include:

- Cedrus deodara / Deodar Cedar
- Cupaniopsis anacardioides / Carrot Wood
- Ilex altaclarensis 'Wilsonii' / Wilson Holly
- Laurus nobilis 'Saratoga' / Sweet Bay
- Olea europaea / Olive (male specimens only)
- Pittosporum undulatum / Victorian Box
- Quercus ilex / Holly Oak
- Quercus suber / Cork Oak

- Quercus virginiana / Southern Live Oak
- Rhus lancea / African Sumac
- Tristania conferta / Brisbane Box
- Umbellularia californica / California Bay

Use native or drought tolerant plants to decrease the need for supplemental irrigation. Root barriers are suggested if trees will not be irrigated once established.

5.3.9 Amend Soils

Physical, chemical and/or biological properties of soils can be improved through the addition of soil amendments. The potential hydrologic benefits of compost amended soils include increasing the soil's permeability and water holding capacity, thereby delaying and often reducing the peak stormwater runoff flow rate, and decreasing irrigation water, fertilizer and pesticide requirements.

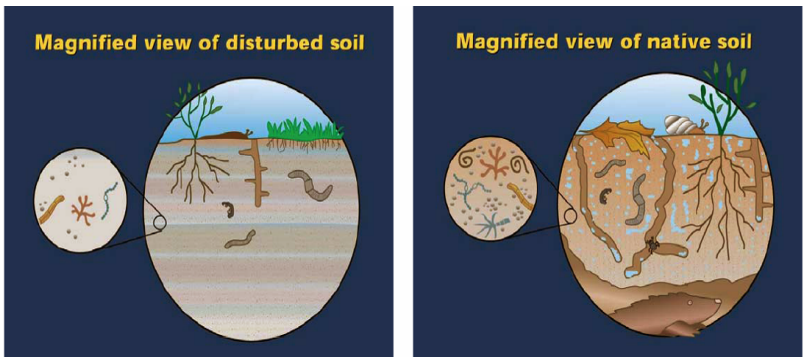


Figure 5.13 Disturbed vs Native Soil
Source: www.deq.state.or.us/lq/pubs/docs/sw/compost/RestoringSoilHealth.pdf

Disruption of soil can kill most of the beneficial biota and remove the air spaces in the soil that the aerobic biota need to thrive. Surface plantings, fertilizer and other nutrient supplements typically only help the first few inches of soil to develop new biota. Chemical fertilizer addition can actually kill or restrict the development of this biota. The biota is necessary for healthy vegetation.

A cup of undisturbed native topsoil can contain numerous bacteria, fungi, protozoa, nematodes, earthworms and arthropods. These living organisms are essential for maintaining healthy soil.

Where soil impacts cannot be avoided or sterile fill is brought in, the soil organic matter can be restored through numerous materials such as compost, composted yard waste, industrial by-products and wood residuals. It is important that the materials used to improve post-construction soil quality be appropriate and beneficial to the plant cover to be established.

<u>Applicability</u>
These procedures are suitable for soils that have been compacted as a result of construction or previous land use and for soils where the organic quality has been compromised due to overuse of pesticides and fertilizers or an exposure to household/industrial chemicals, concentration of pet waste or extreme and unnatural temperatures.

Limitations

Soil testing should be done to verify that soil amendments will produce a soil with similar chemistry, fertility and biology found in healthy regional soils.

Design Criteria

To the extent possible,

- Wherever the subsoil has been compacted by equipment operation, ripping, spading or tilling of the soil is recommended to alleviate soil compaction Amending existing soil mitigates sub-soil compaction when compost is incorporated to a 12 inch depth.
- The upper eight inches of existing soils should be amended to restore the soil organic matter to pre-disturbed levels.