Chapter 2. Integrated Approach to Stormwater Management

Integrated Planning and Design Approach

In order for site designs to reflect the best stormwater management strategies, it is essential that stormwater be considered early in the site design process—before the site layout is established. Otherwise, the choice/location of stormwater controls will be constrained by prior site design decisions (e.g., predetermined grading contours), and may be limited to more expensive, higher-maintenance, and less aesthetically pleasing options.

When stormwater controls are considered early, they can be effectively integrated into site design and planning. There are often opportunities to use existing or proposed site features for stormwater controls and/or repeat small-scale stormwater controls over an entire site. Small-scale controls are typically low-cost and cumulatively very effective.

In some cases, site design necessitates trade-offs among competing goals; however, especially when considered early in the process, stormwater goals can often complement other goals and agency requirements, including those related to vegetation preservation, landscaping, aesthetics, open space, recreational areas, and/or habitat.

Benefits of the Integrated Approach

Benefits to the Property Owner/Developer

Stormwater quality features that are integrated into the fabric of a community, designed to be aesthetically pleasing and provide recreational opportunities and/or aquatic habitat may increase property values. Property values at a subdivision built in the 1970's in Davis, California (Village Homes) have been reported to be higher than those of comparable homes in nearby conventionally-designed subdivisions (*Start at the Source*). This community was designed with seasonal vegetated swales in place of storm drain pipes, community open space, a downstream constructed wetland (the West Davis Pond) and other environmental features.

Environmental Benefits

There are various environmental benefits that can be achieved by protecting natural features, maintaining pre-developed drainage patterns, and/or integrating stormwater quality features into site design:

- Cleaner and cooler runoff delivered to local creeks and rivers

- Cleaner and cooler air due to protected and/or added trees and other vegetation and reduced impervious surfaces
- Protected, and/or added habitat for birds, fish and other wildlife
- Improved water quality by reducing channel erosion

Community Benefits

Well-designed stormwater quality facilities can add value to a community or business setting and improve the quality of life for residents and tenants. Whether or not these features are viewed as an asset depends in large part on how they are incorporated into the overall development project. When small-scale local stormwater controls are considered at the very beginning of the design process, there are more opportunities to integrate them into landscaping as attractive amenities rather than placing them underground. In the right setting, when stormwater quality facilities can be seen and appreciated and their function is explained to residents and tenants, they may foster a natural resource stewardship ethic. Also, landscape-based features, especially those designed using native and drought-tolerant plants, can have less intensive maintenance needs than underground devices.

Similarly, larger-scale regional facilities such as water quality detention basins can be designed to provide tremendous benefits when these are considered early in the process; they can be featured prominently as an attractive amenity and community resource with passive recreation benefits. When such facilities are placed behind residents' backyards or in a forgotten fenced-off corner of the development, the community benefits are lost.

Strategies for Effectively Integrating Stormwater Quality Management into Project Design

Assemble a Collaborative Team Early

In order for site designs to reflect the best stormwater management strategies, stormwater controls must be considered early in the site design process. To do that, involve the project engineer and other design professionals during the conceptual design stage, when the initial site layout is being determined. In the past, only planners and architects may have been involved at this stage of the design.

The collaborative design process may involve the following key players:

- Project Owner
- Permitting Agency Staff
- Planners
- Architects
- Engineers (Civil, Geotechnical)
- Landscape Architects
- Arborists
- Environmental Consultants

Table 1-1 in Chapter 1 indicated the various roles that each of these individuals can play in each phase of the planning and design work.

It is also helpful to arrange a meeting with the local permitting agency to get agency input at the conceptual design stage; in most jurisdictions, this is referred to as the pre-application meeting.

It is equally important that those involved in site planning and design work collaborate throughout the site design process; that way, stormwater quality features can be optimally integrated into the site and project design. This might be facilitated by periodic meetings of the project team and by routing various designs to the different disciplines for review and comment.

Consider the Site and its Surroundings

Gather information about the following site characteristics, which will greatly influence the type of stormwater quality controls used on your project:

- **Existing natural hydrologic features** and natural resources, including any contiguous natural areas, wetlands, watercourses, seeps, or springs.
- **Existing site topography**, including contours of any slopes of 4% or steeper, general direction of surface drainage, local high or low points or depressions, and any outcrops or other significant geologic features.
- **Zoning**, including requirements for setbacks and open space.
- **Soil types** (including hydrologic soil groups) and depth to groundwater, which may determine whether infiltration is a feasible option for managing site runoff. A preliminary determination of infiltration feasibility may be made using maps in hydrology and flood control design manuals published by the local permitting agency. Also, site-specific information (e.g. from boring logs or geotechnical studies) may be required by the permitting agency, depending on the site location and characteristics.
- **Existing site drainage**. For undeveloped sites, determine drainage patterns by inspecting the site and examining topographic maps and survey data. For previously developed sites, locate site drainage and connections to the municipal storm drain system from a site inspection, municipal storm drain maps, and/or the approved plans for the existing development (typically on file with the local municipality).
- **Existing vegetative cover** and impervious areas, if any.
- **Existing trees** and arborists report, if any.

Identify Opportunities and Constraints

Using the site features information gathered above, identify the principal opportunities and constraints for stormwater quality management on the site.

Opportunities might include existing natural areas, low (depressed) areas, oddly configured or otherwise un-developable parcels, easements, and open space (which potentially can double as locations for stormwater quality controls with the permitting agency's approval). Also look at elevation differences on the site which might provide hydraulic head for structural treatment control measures.

Constraints might include impermeable soils, high groundwater, contaminated soils or groundwater, steep slopes, geotechnical instability, existing utilities, high intensity land use, expected heavy pedestrian or vehicular traffic, safety concerns, or compatibility with surrounding land uses. Also there might be competing environmental concerns on the project site.

Preserve Valuable Site Features

Consider these techniques to preserve natural and environmentally-sensitive features on your site:

- Define development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Cluster the development to conserve natural areas and provide open space for the new residents/tenants to enjoy.
- Preserve natural vegetation. Vegetation is an integral part of the natural hydrologic cycle. Vegetation intercepts rainfall, and plant roots take up water that soaks into the ground. Also, roots and decaying organic matter such as leaf litter protect the soil structure and soil permeability, and therefore help preserve the pollutant-removal processes that occur in soil. When designing a site, retain as much natural vegetation as possible.
- Consider preserving trees (consider the number, quality and health and location of existing trees), even if the local jurisdiction would allow their removal, for all the reasons given above.
- Set back the development from creeks, wetlands, and riparian habitats. Check with the local agency regarding minimum setback requirements.
- Designate and protect natural buffers for waterways and natural areas. If disturbing buffer areas during construction is unavoidable, make plans to replant them with plants and trees adapted and suited to the site conditions, preferably low-water use plants. Such plants have a better chance of survival and adaptation to the site over time without an over reliance on water and fertilizers/pesticides.

Lay Out the Site with Topography and Soils in Mind

To minimize stormwater-related impacts, consider applying the following design principles to the site layout:

- Choose a design that replicates the site’s natural drainage patterns as much as possible.
- Where possible, conform the site layout to natural landforms.
- Identify topographic lows that might be suitable for locating stormwater quality treatment features.
- Concentrate development on portions of the site with less permeable soils and preserve areas that will actively promote infiltration.
- When possible, avoid disturbing steep slopes and erodible soils.
- When possible, avoid excessive grading and disturbance of vegetation and soils.
- When possible, avoid the use of closed conduit systems.
- When possible, avoid compacting soils in open and/ or landscape areas.

Put Landscaping to Work

All permitting agencies require landscaping for most development projects, for both aesthetic and shading purposes, and sometimes for noise reduction. Stormwater quality features can often be integrated into landscape areas such as the site perimeter, parking medians, and roadside areas. For example, instead of mounding the landscaped areas in a business center parking lot, consider creating depressed areas (i.e. bioretention, swales) to accept and filter the water before sending it off the site. Using landscape areas for stormwater quality features may require some changes in the conventional approach to landscape designs, and may result in larger/wider landscape areas. Check with your local permitting agency regarding specific landscaping and tree requirements and related requirements such as water conservation. Additional information can be found in Chapter 4, **Source Control Measures**, at www.beriverfriendly.net and the State's Department of Water Resources Model Water Efficient Landscape Ordinance AB 1881.

Stop Pollution at Its Source

Rather than managing stormwater runoff only at the final point of discharge from a site, look for opportunities to manage pollution where it is first generated. Source control measures keep pollutants from entering stormwater to begin with, whereas treatment control measures remove pollutants from stormwater runoff. Chapter 4, **Source Control Measures** presents a variety of source controls for new development and redevelopment, such as:

- Marking storm drain inlets with "No Dumping" messages to deter illegal dumping.
- Locating and designing outdoor trash enclosure areas so that polluted runoff from these areas does not enter the storm drain system.
- Designing vehicle wash areas so that soapy, polluted water is not delivered to the storm drain system.

Specific source controls are required for various types of development projects (see **Table 3-3** in Chapter 3, **Steps to Managing Stormwater Quality**), but also look for additional ways to stop pollution at the source.

Reduce Runoff Close to Its Source

Another way to stop pollution at its source is to reduce runoff wherever possible through the incorporation of low impact development (LID) measures. Reducing site runoff will also reduce the volume and duration of flows to local creeks, thus reducing the potential for downstream erosion and habitat impairment. LID measures are required for all projects. LID measures can reduce project costs for projects that typically require runoff treatment because this can reduce the need for stormwater quality treatment.

The main ways to reduce runoff are to promote infiltration, minimize impervious surfaces, disconnect impervious surfaces (disconnecting impervious surfaces means to intercept the runoff by draining the roof or pavement to a pervious area and not directly to the storm drain system), and promote planting of trees and shrubs to intercept and slow the runoff.

Promote Infiltration Where Feasible

On undeveloped, undisturbed land, rain slowly percolates into the soil and impurities are filtered out and transformed through natural biological processes. When designing a site, look for ways to promote infiltration and allow soil to filter and naturally transform impurities. For example, consider dispersing runoff over a landscaped area. Of course, infiltration is not appropriate where it would pose a threat to groundwater quality or cause other problems such as destabilizing a site.

As part of an amended soil layer, proper mulch can also have a measurable benefit in promoting infiltration by supporting a healthy soil, trapping moisture, and slowing the runoff. Select shredded mulches that are non-floating. Per Order No. R4-2012-0175, "Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. It is recommended to apply 1 inch to 2 inches of composted mulch, once a year, preferably in June following weeding."

Consider infiltration stormwater quality treatment control measures for your site where feasible. Chapter 5, **Hydromodification Management, Low Impact Development, and Treatment Control Measures** includes design information for two such devices: the infiltration basin and infiltration trench.

Minimize Impervious Surfaces

For all types of development, try to limit overall coverage of paving and roofs. This can be accomplished—where consistent with local zoning regulations and development standards—by designing compact, taller structures, narrower and shorter streets and sidewalks, smaller parking lots (fewer/smaller stalls where possible, and more efficient lanes), and indoor or underground parking. Examine site layout and circulation patterns and identify areas where landscaping, porous pavement, or planter boxes can be substituted for pavement.

Where Feasible, Avoid Draining Impervious Areas Directly to a Storm Drain

When the built and landscaped areas are defined on your site drawings, look for opportunities to minimize impervious areas that are directly connected to the storm drain system. Chapter 5 presents information on several options that can be considered for this, including:

- **Direct runoff from impervious areas** to adjacent pervious areas or depressed landscaped areas.
- **Select porous pavements and surface treatments**. Inventory paved areas on the preliminary site plan and identify locations where permeable pavements, such as crushed aggregate, turf block, or unit pavers can be substituted for conventional concrete or asphalt paving. Typically, these materials work best in low-traffic parking areas, rather than high-traffic areas such as drive aisles.

Chapter 5 describes how to quantify the benefits achieved by your design decisions to reduce paved and roofed areas, to create landscaped areas and pervious pavements which retain water, and to direct runoff from impervious to pervious areas.

Treat Runoff

Treating runoff is required for projects above certain size thresholds (which vary with respect to project category -- see Table 3-2 and Table 3-3. As previously noted, providing LID measures can reduce or possibly even eliminate the required treatment.

Treatment is accomplished by either detaining runoff long enough for pollutants to settle out or by filtering runoff through sand, soil, engineered media, or soil matrix. Typically, the limiting design factors will be available space, available hydraulic head (difference in water surface elevation between inflow and outflow), and soil permeability. In some cases, a small adjustment of elevations within the site plan can make a particular treatment option feasible and cost effective.

When developing a drainage and treatment strategy, also consider whether to route most or all drainage through a single detention and treatment control measure or to disperse smaller control measures throughout the site. Directing runoff to a single treatment area may be simpler and easier to design, but designs that integrate smaller techniques such as swales, small landscaped areas, and planter boxes throughout the site are typically more cost-effective, less maintenance intensive, and more attractive. Chapter 5, **Hydromodification Management, Low Impact Development, and Treatment Control Measures** describes various treatment control measures that are acceptable for use in the Sacramento region, such as:

- Three types of water quality detention basins (dry, wet and combination)
- Underground wet vaults or tanks
- Infiltration basin and trench
- Sand filter
- Bioretention planter
- Vegetated swale and filter strip

Hydromodification Management

Urbanization will often cause an increase in peak flow as well as runoff duration. These increases can artificially accelerate erosion and sedimentation within receiving waters. Hydromodification control measures should be provided (as required) to mitigate this effect. These measures function through attenuation, infiltration, and dispersion of runoff. Chapter 5 includes more detailed information regarding the applicability of hydromodification management and the implementation of hydromodification management measures. Refer to the Sacramento Stormwater Quality Partnership Hydromodification Management Plan, Figure 5-1 Hydromodification Mitigation Applicability Flow Chart, and Figure 5-2 Applicability Map.

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Additional Resources

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