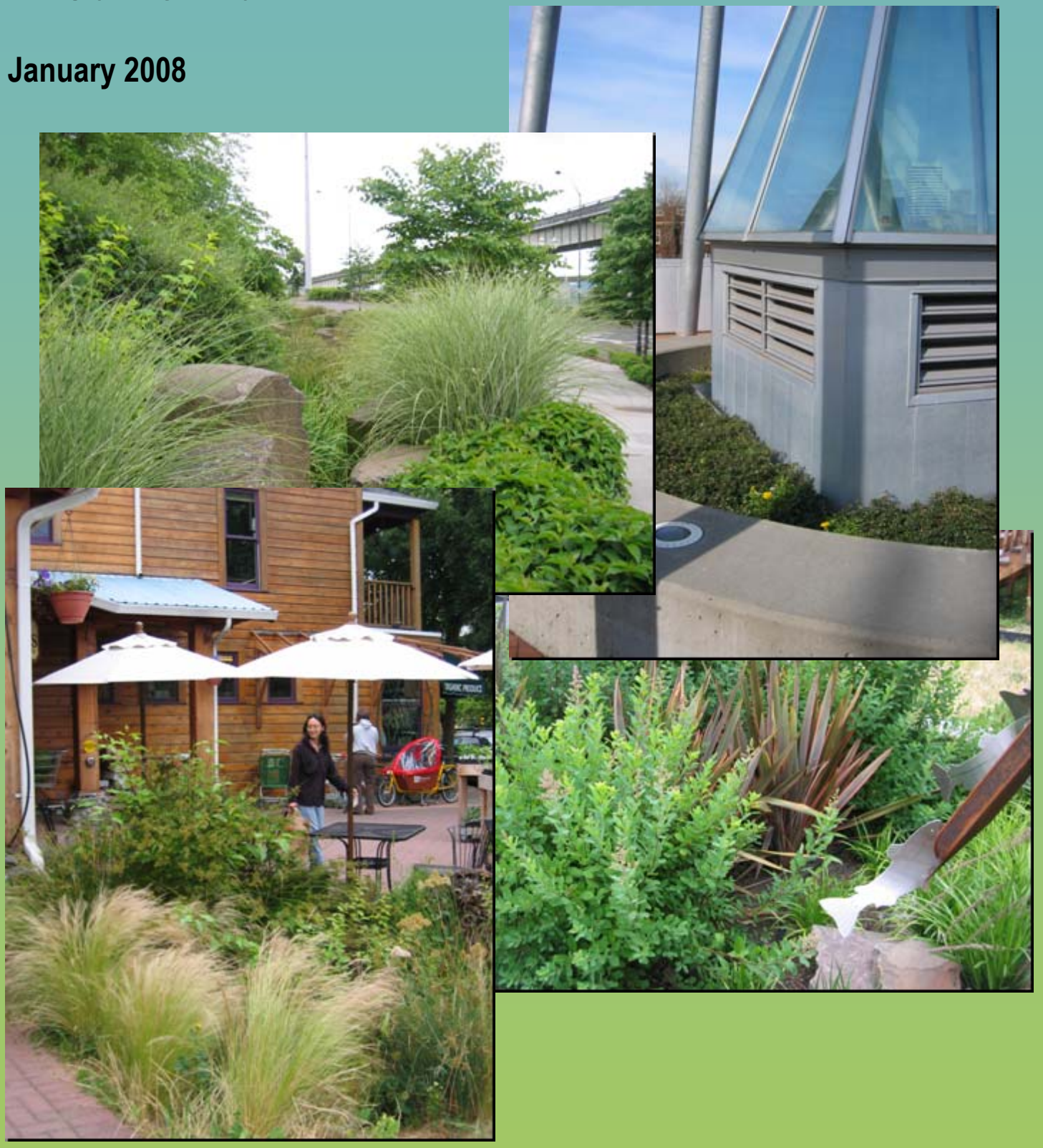
Attachment 1

State and Local Policies Encouraging or Requiring Low Impact Development in California

January 2008



Prepared for the
Ocean Protection Council of California

Prepared by TETRA TECH

State and Local Policies Encouraging or Requiring Low Impact Development in California

Final Report

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Ocean Protection Council

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Executive Summary

Stormwater pollution occurs when rain falls onto developed areas. Under natural conditions, much of the rainwater soaks into the soil, returning to streams, lakes, and other waterbodies through the ground. Surface runoff is usually limited and is slowed by dense vegetation. With development, specifically with the creation of impervious surface such as streets, driveways, sidewalks, and roofs, rain is prevented from infiltrating into the ground, causing it to flow over the surface in much larger quantities. Along the way this runoff mobilizes pollutants and transports them to waterbodies where they eventually flow to the Pacific Ocean.

In California, 691 waterbodies are considered impaired because water quality is too poor to support designated uses.[1] Of these impaired waterbodies, 110 are bays and harbors, 39 are estuaries, and 4 are tidal wetlands, indicating that pollution is affecting California's coastal resources. Urban runoff-related pollutants, such as pathogens, nutrients, metals (e.g., mercury, copper, lead), sediment, and toxic chemicals, are among the top causes of impairment statewide. Many California communities have issued a standing warning to avoid swimming, surfing, or other contact recreation at beaches for 72 hours after rainstorms due to high bacterial counts and increased concentrations of other potentially harmful pollutants being discharged from stormwater outfalls. Beach closures and swimming restrictions are commonly attributed to urban runoff, in some cases even during dry weather. Urban runoff can cause physical damage by accelerating stream channel erosion, modifying instream aquatic habitat, and altering riparian zones. Flood damage can also be more frequent and severe when runoff is not properly mitigated.

The effects of urban runoff have been exacerbated by stormwater management techniques popularized after World War II, in which drainage systems were designed to rapidly convey vast amounts of stormwater through gutters and pipes with no attenuation or pollutant removal. These high-volume, high-velocity flows have eroded stream channels, destroyed habitat, and caused flooding and property damage.

In the past decade a stormwater management technique called Low Impact Development (LID) has been gaining ground as the preferred method for mitigating stormwater impacts. The technique minimizes hardscape and uses the pervious surfaces on a development site, such as landscaped areas, to infiltrate and/or temporarily store runoff, allowing the site to more closely mimic a "natural" state with respect to hydrology. LID site design incorporates such diverse practices as bioswales, filter strips, flow-through planter boxes, porous pavement, cisterns, rain barrels, green roofs, and other micro-scale best management practices, allowing a great deal of flexibility in design. Widespread application of LID practices is expected to help restore the natural water balance when used in redevelopment and infill applications, which is particularly important in urbanized areas to help reverse the ill effects of past development. LID is also expected to maintain the hydrologic balance and reduce pollutants in newly developing areas, helping to ensure protection of high-quality water resources.

Regulations are in place in California and nationwide to prevent and/or mitigate the effects of stormwater pollution. The California State Water Resources Control Board and Regional Water Quality Control Boards have set requirements for municipalities and construction sites to control stormwater under the National Pollutant Discharge Elimination System regulations. Municipal stormwater permits developed by the Regional Water Quality Control Boards in Southern California and the San Francisco Bay area have begun to incorporate explicit LID requirements. These requirements are not standardized and only apply locally, however, limiting their impact statewide. The draft Construction General Permit includes incentives to incorporate LID techniques in stormwater plans statewide and will apply to most new and redevelopment. However, comprehensive state legislation could be adopted to "set the bar" for LID

[1] EPA. 2008. *2006 Section 303(d) List Fact Sheet for California*. http://iaspub.epa.gov/waters/state_rept.control?p_state=CA

incentives and requirements to ensure that all of the State's water resources are protected. Recommended language should be based on existing models within California and in other areas, integrating the "best of the best" while balancing the needs of large, urban communities with those of smaller, suburban or rural communities.

Beyond statewide legislation, other opportunities exist to integrate LID into related programs and initiatives. Stormwater concerns dovetail nicely with smart growth, watershed protection, water conservation, and green building initiatives, for example. Dialog and partnerships among State and local agencies, environmental groups, trade associations, water agencies, academia, and citizen groups will be essential for LID to become "business as usual" in California, with benefits not only to water quality but also for community livability and sustainability.

This report includes background information on stormwater pollution and impervious surface effects (Section 1). Section 2 presents an overview of LID principles and practice along with highlights of agencies and organizations that have incorporated LID. Section 3 categorizes a variety of options for state, regional, and local LID requirements, while Section 4 summarizes existing stormwater regulations in California and elsewhere and integrates these examples into recommendations for statewide LID legislation if the state were interested in adopting such requirements. Section 5 discusses ways in which LID can be incorporated into local codes, ordinances, and standards, along with programmatic steps communities can take to improve LID program administration. Key elements of progressive stormwater codes and ordinances are included as models for other communities. Finally, a procedure and criteria are presented that would assist a State agency in evaluating applications if grant funding is made available for local LID planning and implementation projects.

This report is intended to describe ways in which LID practice can be enhanced in California on state, regional, and local levels. It is meant to complement the policy analysis and recommendations outlined in the December 2007 report from the California State Water Resources Control Board Stormwater Program and The Water Board Academy, *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption*. Other recent reports provide a different perspective on LID, such as two 2007 reports evaluating costs and benefits of LID practices: *The Economics of Low Impact Development: A Literature Review* by ECONorthwest[2] and the U.S. Environmental Protection Agency's *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*.[3] Technical guidance for LID is continually being developed on the local and regional levels, and many of these guidance manuals provide valuable, location-specific guidelines for LID applicability along with detailed design, installation, and maintenance specifications.

[2] ECONorthwest. 2007. *The Economics of Low Impact Development: A Literature Review*. http://www.econw.com/reports/ECONorthwest_Low-Impact-Development-Economics-Literature-Review.pdf.

[3] EPA. 2007. *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*. http://www.epa.gov/owow/nps/lid/costs07/documents/reducingstormwatercosts.pdf.

1 Introduction

1.1 Overview of Impervious Surfaces

The term impervious surface refers to land cover, both natural and human-made, that cannot be penetrated by water. Consequently, precipitation that falls on impervious surfaces does not infiltrate into the soil. Instead, it runs off to a pervious area where all or a portion infiltrates into the soil, or it continues to travel down-slope on impervious surfaces, including saturated soils, until it is eventually conveyed to a ditch, a storm drain network, or a receiving waterbody. Most of the impervious cover in an urban watershed or subwatershed is from rooftops, roads, sidewalks, driveways, parking lots, and recreational facilities (e.g., tennis courts, swimming pools, etc.).

Impervious surface is typically measured as total impervious area or effective impervious area. Total impervious area includes all impervious cover in the watershed and is typically represented as a percent of the entire watershed area. Effective impervious area is the portion of impervious cover that is directly connected to stormwater conveyance systems or receiving waterbodies. Effective impervious area tends to be a better proxy for hydrologic and pollutant impacts from development because flows from these areas are not infiltrated, evaporated, or otherwise treated before being discharged to waterbodies. In many cases, a large portion of total impervious area can be "disconnected" by diverting flows to pervious surfaces such as landscaped areas. For example, gutter downspouts on residential homes can be disconnected to direct flows over the lawn or into infiltration basins.

Both the amount of impervious area and the relationship between total and effective impervious areas vary according to land use.[4] For example, work in the Puget Sound area revealed that total impervious area in low-density residential sites averaged approximately 10 percent, with an effective impervious area of only 4 percent. In commercial and industrial areas, however, total impervious area averaged about 90 percent. Almost all of the total impervious area is also effective impervious area because of the lack of pervious areas to break up direct connections.

1.2 Effects of Increased Imperviousness

Watershed imperviousness plays an important role in determining the conditions in waterbodies because it leads to more runoff. Increased runoff carries more pollutants to receiving waters and transports them faster than they would normally travel with the help of streets, driveways, parking lots, rooftops, sidewalks, curbs, gutters, and storm drain pipes. Increased runoff also has physical effects on streams and rivers—the larger, faster flows are more erosive and can alter the size, shape, and habitat quality of channels. Higher runoff volumes also exacerbate flooding and property damage.

Impervious cover is an inescapable attribute of development and a permanent part of the urban/suburban landscape. As might be expected, there is a linear relationship between impervious surface in a given area and the amount of runoff generated. What is unexpected is what this means in terms of both the volume of water generated and the rate at which it exits the surface. Depending on the degree of impervious cover, the annual volume of storm water runoff can increase to anywhere from 2 to 16 times the predevelopment amount.[5] Impervious surface coverage as low as 10 percent can destabilize a stream channel, raise water

[4] Caraco, D., R. Claytor, P. Hinkle, H.Y. Kwon, T. Schueler, C. Swann, S. Vysotsky, and J. Zielinski. 1998. *Rapid Watershed Planning Handbook*. Center for Watershed Protection, Ellicott City, MD.

[5] Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques* 1(3): 100–111.

temperature, and reduce water quality and biodiversity.[6] One study found that connected imperviousness levels between 8 and 12 percent represented a threshold region where minor changes in urbanization could result in major changes in stream condition.[7] Table 1 provides a detailed summary of the effects of urbanization and increased imperviousness on streams.

Table 1. Urbanization Effects on Streams. [8]

Effect	Description
Bankfull and subbankfull floods increase in magnitude and frequency	The peak discharge associated with the bankfull flow (the 1.5- to 2-year return storm) increases sharply in magnitude in urban streams. Channels experience more bankfull and subbankfull flood events each year and are exposed to critical erosive velocities for longer intervals.
Dimensions of the stream channel are no longer in equilibrium with its hydrologic regime	The hydrologic regime that defined the geometry of the predevelopment stream channel irreversibly changes, and the stream experiences higher flow rates on a more frequent basis. The higher-flow events of the urban stream are capable of moving more sediment than before.
Channels enlarge	The customary response of an urban stream is to increase its cross-sectional area to accommodate the higher flows. This is done by streambed downcutting, channel widening, or a combination of both. Urban stream channels often enlarge their cross-sectional area by a factor of 2 to 5 depending on the degree of impervious cover in the upland watershed and the age of development.
Stream channels are highly modified by human activity	Urban stream channels are extensively modified in an effort to protect adjacent property from streambank erosion or flooding. Headwater streams are frequently enclosed within storm drains, while other streams are channelized, lined, and/or “armored” by heavy stone. Another modification unique to many urban streams is the installation of sanitary sewers underneath or parallel to the stream channel.
Upstream channel erosion contributes greater sediment load to the stream	The prodigious rate of channel erosion coupled with sediment erosion from active construction sites increases sediment discharge to urban streams. Researchers have documented that channel erosion constitutes as much as 75 percent of the total sediment budget of urban streams. Urban streams also tend to have a higher sediment discharge than non-urban streams, at least during the initial period of active channel enlargement.
Dry weather flow in the stream declines	Because impervious cover prevents rainfall from infiltrating the soil, less flow is available to recharge ground water. Consequently, during extended periods without rainfall, baseflow levels are often reduced.
Wetted perimeter of the stream declines	The wetted perimeter of a stream is the proportion of the total cross-sectional area of the channel that is covered by flowing water during dry weather, and it is an important indicator of habitat degradation in urban streams. Given that urban streams develop a larger channel cross-section at the same time that their base flow rates decline, it follows that the wetted perimeter will become smaller. Thus, for many urban streams, this results in a very shallow, low-flow channel that “wanders” across a very wide streambed, often changing its lateral position in response to storms.

[6] Schueler, T. 1995. *Site Planning for Urban Stream Protection*. Metropolitan Washington Council of Governments, Washington, DC.

[7] Wang, L., J. Lyons, P. Kanehl, and R. Bannerman. 2001. Impacts of Urbanization on Stream Habitat and Fish Across Multiple Spatial Scales. *Environmental Management* 28(2): 255–266.

[8] U.S. Environmental Protection Agency. 2005. *National Management Measures to Control Nonpoint Source Pollution from Urban Areas*. Office of Water, Washington, DC.

Table 1. Urbanization Effects on Streams. [8]

Effect	Description
Instream habitat structure degrades	Urban streams are routinely scored as having poor instream habitat quality, regardless of the specific metric or method employed. Habitat degradation is often exemplified by loss of pool and riffle structure, embedding of streambed sediments, shallow depths of flow, eroding and unstable banks, and frequent streambed turnover.
Large woody debris is reduced	Large woody debris is an important structural component of many low-order stream systems because it creates complex habitat structure and generally makes the stream carry more water. In urban streams, the quantity of large woody debris found in stream channels declines sharply because of the loss of riparian forest cover, storm washout, and channel maintenance practices.
Stream crossings and potential fish barriers increase	Many forms of urban development are linear in nature (e.g., roads, sewers, and pipelines) and cross stream channels. The number of stream crossings increases in direct proportion to impervious cover, and many crossings can become partial or total barriers to upstream fish migration, particularly if the streambed erodes below the fixed elevation of a culvert or pipeline.
Riparian forests become fragmented, narrower, and less diverse	The important role that riparian forests play in stream ecology is often diminished in urban watersheds as tree cover is often partially or totally removed along the stream as a consequence of development. Even when stream buffers are preserved, encroachment often reduces their effective width and native species are supplanted by exotic trees, vines, and ground covers.
Water quality declines	The water quality of urban streams during storms is consistently poor. Urban storm water runoff contains moderate to high concentrations of sediment, carbon, nutrients, trace metals, hydrocarbons, chlorides, and bacteria. Although considerable debate exists as to whether storm water pollutant concentrations are actually toxic to aquatic organisms, researchers agree that pollutants deposited in the streambed exert an undesirable impact on the stream community.
Summer stream temperatures increase	The impervious surfaces, ponds, and poor riparian cover in urban watersheds can increase stream temperatures by several degrees. Because temperature plays a central role in the rate and timing of instream biotic and abiotic reactions, such increases have an adverse impact on streams. In some regions, summer stream warming can irreversibly shift a cold-water stream to a cool-water or even warm-water stream, resulting in deleterious effects on salmonids and other temperature-sensitive organisms.
Reduced aquatic diversity	Urban streams are typified by fair to poor fish and macroinvertebrate diversity, even at relatively low levels of watershed impervious cover or population density. Declines in sensitive species have been observed at levels of impervious cover as low as 4 percent. Impervious cover in highly urbanized areas comprising greater than 25 percent of a watershed may even preclude the Clean Water Act goal of “fishable” waters. The ability to restore predevelopment fish assemblages or aquatic diversity is constrained by a host of factors, including irreversible changes in carbon supply, temperature, hydrology, lack of instream habitat structure, and barriers that limit natural recolonization.

Figure 1 shows the relationship between impervious cover and aquatic insect diversity; Figure 2 shows the relationship between imperviousness and fish diversity.

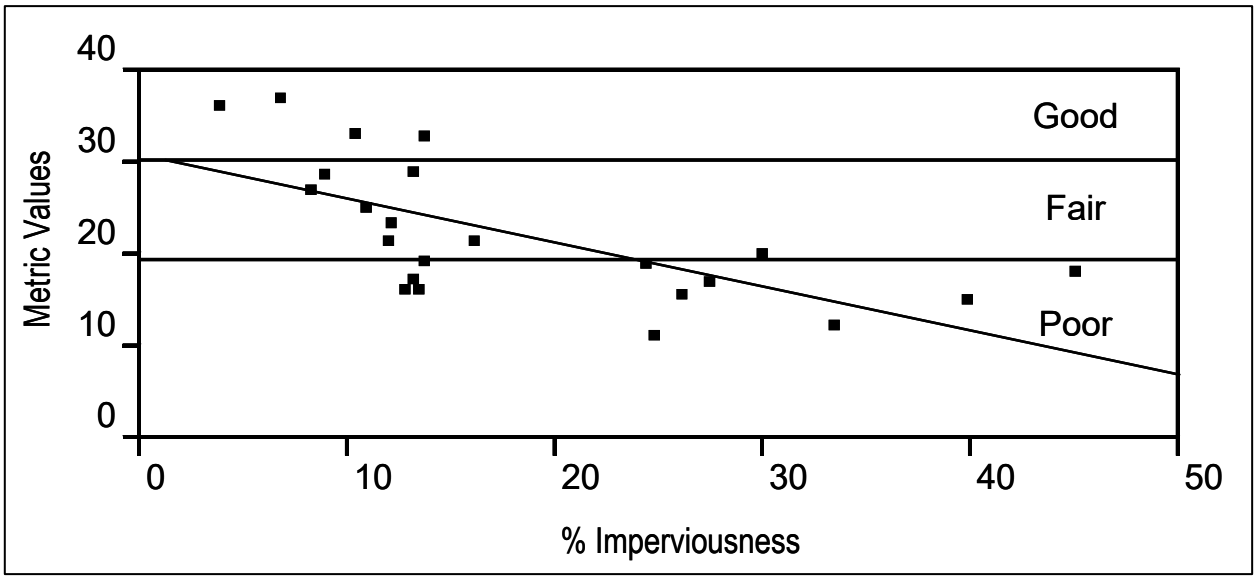

Figure 1. Relationship between impervious cover and aquatic insect diversity in Anacostia River subwatersheds (Schueler and Galli, 1992, as cited in Schueler, 1995).

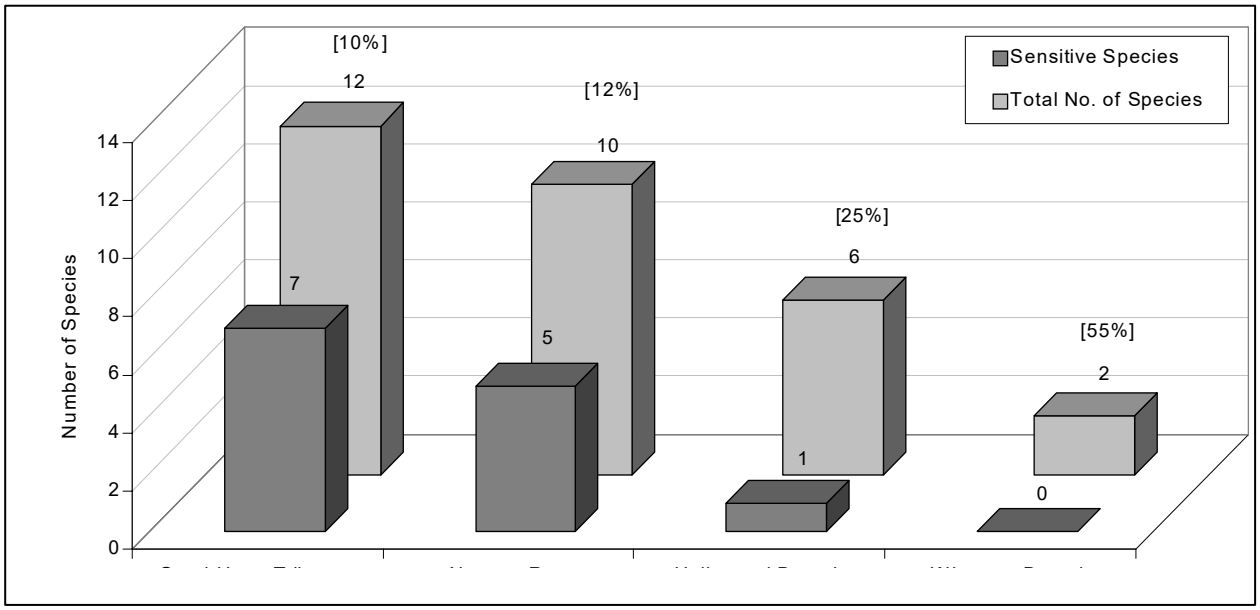

Figure 2. Fish diversity in four subwatersheds of different impervious cover in the Maryland Piedmont (Schueler and Galli, 1992, as cited in Schueler, 1995).

2 Low Impact Development

2.1 What is Low Impact Development?

According to the Low Impact Development Center, Low Impact Development, or LID, is a stormwater management strategy concerned with maintaining, mimicking or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives. LID addresses stormwater through small, cost-effective site design and landscape features that are distributed throughout the site. In shorthand, LID is often referred to as a requirement that the post-development stormwater runoff profile equal the pre-development conditions, both in terms of volume and rate.

Best management practices associated with LID typically come in the form of "green" or non-structural practices. Some conventional practices are often used, such as dry detention basins and swales. Modified landscaping is increasingly popular since cities often already have landscaping codes in place.[9] The modifications include use of engineered soils for water handling purposes, tree canopy requirements, use of native landscaping, and the use of cisterns and other runoff storage devices. In residential settings, rain gardens, coving, and storage devices such as rain barrels and cisterns are being promoted or required. While conventional house designs often directed downspouts to paved driveways, new designs for both pervious driveway surfaces and diverted flow into natural areas are likely to become standard practice.

While initial LID practices were mainly written for new residential subdivisions, a new generation of practices (and combination of practices) has emerged for commercial applications and urban settings that cannot rely on large parcels for infiltration. As such, green roofs, permeable paving, improved parking lots, and landscaping are gaining attention. In some cases, a combination of "green" techniques and structural practices (e.g., vaults) will be needed to meet performance goals.

While many communities are adopting informal guidelines on LID, regulatory recognition of LID is increasing at the State and local levels. Established LID programs exist at the State level in Maryland, Washington, and Massachusetts. Some States have adopted LID requirements for sensitive areas, for example the Pinelands region of New Jersey. Among cities, Portland, Oregon, and Chicago, Illinois, are leaders.

LID programs vary around the country, with differing performance standards, definitions, and regulatory structures. In most cases, the program first establishes the baseline natural hydrologic regime, and sets development performance based on meeting targets for runoff volume, runoff rates, and pollutant loads.

With LID, it is important to strike a balance that recognizes the impact that development has on ecology and hydrology. Establishing the baseline, pre-development condition may seem simple, but it would be unrealistic to expect that true pre-development conditions can be achieved fully. The baseline might be set higher where waterbodies are impaired, for example, requiring development to mimic the hydrology of a forest, even if the predevelopment condition provides lower ecological services. On the other end of the spectrum, some locales set the pre-development condition based on the status of the site immediate to construction. Thus, redevelopment of a 100 percent impervious site under this type of regulation need only meet minimal (or no) on-site stormwater requirements. Realistic requirements should be written to strike a balance: achieve improvement over existing conditions but take into account economic development goals and site constraints.

[9] Note that California has State standards for commercial landscaping; this code is currently being amended under 2006 legislation for water conservation.

For regulatory structures, LID can be introduced in several ways:

- A new, stand-alone code
- Integrated codes (that is, integrated into existing zoning and building codes)
- Subdivision regulations, sub-area plans, or specific plans
- Guidelines
- Alternative compliance programs

Like other planning programs, LID is constantly evolving. Research and policy options for LID at a larger scale are now underway. In fact, one of the weaknesses of early LID efforts was its confinement to individual sites and projects. Green highways and green infrastructure are commanding a great deal of attention. LID at the district scale is also likely to gain profile for development designs where individual lots are not likely to meet strict performance measures. Finally, policy options for retrofitting existing development with LID techniques will gain attention, in particular for built out watersheds draining to impaired waterways.

2.2 LID ON MULTIPLE SCALES: CONSIDERING SMART GROWTH

The intersection of development and watershed planning tends to settle upon one concept: impervious surface. As discussed in section 1, the importance of imperviousness cannot be under-stated and is well known as an indicator of watershed health. Limiting the effects of impervious surface is becoming more common in local zoning codes in the form of impervious surface caps, requirements to disconnect impervious surfaces, and infiltration requirements. Because they are contained in zoning codes, the policies tend to apply to individual sites. Thus, limiting effective impervious surface coverage on individual sites has emerged as the preferred regulatory instrument for limiting the effects of impervious surfaces.

While this approach works in some development contexts, there can be applications that limit the full potential of LID. For new development, it is possible for individual sites to meet LID specifications, even as they add to wider disturbance arising from cumulative and induced development impacts. These often-overlooked impacts arise not because of LID, but because of the underlying pattern of dispersed development. Second, site-level application of LID can pose a challenge in districts that coordinate a higher intensity of development on a compact footprint because space for infiltration may be limited, for example transit area planning, redevelopment of older downtowns, and master-planned town centers.

Early smart growth projects were isolated and did not make full use of on-site and/or distributed stormwater management. Although new designs call for narrow roads, the curbs, gutters and conveyance systems rely on conventional, untreated drainage. For developed areas, improving impaired waterways will be met through retrofits of existing development, not new development. Even though urban redevelopment projects have an implicit watershed benefit by reusing impervious surface, each project will need to contribute to stormwater management and improvement. This is often missing from urban public works planning, in part because the development operating system was built on conventional curb-and-gutter drainage.

These points illustrate the importance of scale when assessing and evaluating low impact and smart growth policies. Those scales include the watershed (or region), the subwatershed (or district), and the site, simultaneously. Successfully coordinating watershed management and reducing the impacts of development typically occur within a comprehensive plan.

2.3 LID ON THE GROUND IN CALIFORNIA

There are a number of California organizations who have made great strides in researching, implementing, and developing guidance for LID. The following are highlights from the California Department of Transportation (Caltrans) and three regional, umbrella stormwater organizations: the Santa Clara Valley Urban Runoff Pollution Prevention Program, the Contra Costa Clean Water Program, and the Alameda Countywide Clean Water Program.

2.3.1 Caltrans

Caltrans has several programs underway to address the installation and retrofit of State roads and highways, though the work can apply to non-State roads as well. Because roads traditionally represent a high degree of connected impervious cover, special attention should be devoted to retrofitting streets with LID. The following summary introduces several Caltrans programs underway that incorporate LID activity.

Best Management Practice Retrofit Pilot Program (2004, 316 pages) – This pilot program was initiated to assess the potential for large-scale retrofit of Caltrans roads with stormwater BMPs. Thirty-two pilot sites in the Los Angeles and San Diego regions were outfitted with a variety of structural and non-structural BMPs. The program produced information on the effectiveness of BMPs in pollutant removal efficiencies, as well as the technical feasibility of the BMPs as retrofits in highway and support facility settings. LID techniques, such as swales, biofiltration, and infiltration, were tested both alone and as part of a "treatment train," where several BMPs were installed in a series. http://www.dot.ca.gov/hq/env/stormwater/special/newsetup/_pdfs/new_technology/CTSW-RT-01-050.pdf

Storm Water Quality Handbook: Project Planning and Design Guide (2007, 354 pages) – This recently revised Handbook incorporates several "green" features, including reference to the 2004 BMP Retrofit study listed above. The foremost consideration in stormwater design is preservation of the maximum amount of vegetative condition no matter the context. The Handbook also notes up front that the requirements are minimal; any roadway within an MS4 would be subject to additional post-construction (or permanent) stormwater management practices. An important feature of the Handbook is the presentation of Accepted Water Quality Treatment BMPs and specifications for their construction, operation, and maintenance. Many techniques used in prominent "green streets" retrofits are included (for example infiltration devices and bioswales). http://www.dot.ca.gov/hq/oppd/stormwtr/Final-PPDG_Master_Document-6-04-07.pdf

2.3.2 Stormwater Management Programs

The issuance of municipal stormwater permits has created a new generation of programs dedicated to not only permit compliance, but also to integration of stormwater runoff into other watershed management and regional planning efforts. In some organizations, stormwater management is housed in traditional flood control programs, while in other programs, new, stand-alone programs were formed to address NPDES requirements. The proliferation of smaller programs has led to larger umbrella organizations like the Bay Area Stormwater Management Agencies Association (BASMAA), which serves as a regional liaison among local and regional governments and the Regional Water Quality Control Boards. Three notable local programs are the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), the Contra Costa Clean Water program, and the Alameda Countywide Clean Water Program (ACCWP).

In 2001, the San Francisco Bay Regional Water Quality Control Board reissued the NPDES permit for MS4s and included a measure called "C.3." As noted previously in this report, this measure, which was landmark, extended stormwater practices to new development and redevelopment projects. Both

SCVURPPP and the Contra Costa programs developed comprehensive program materials to address the new requirements. Details are presented below.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)

SCVURPPP is a program addressing water quality in thirteen cities and towns in the Santa Clara Valley. These cities and towns are responsible for implementing a municipal stormwater permit issued by the San Francisco Bay Regional Water Quality Control Board. According to the program's Website (http://www.scvurppp-w2k.com/default.htm), the five goals of the Program include:

- Permit Compliance
- Establishing Determinants of Success
- Adjusting Activities to Change
- Achieving Acceptance of Urban Runoff Management Activities
- Integrating Urban Runoff Program Elements into Other Programs

To meet these goals, the Program offers a number of services, including workshops, fact sheets, guidance manuals, interpretation of permit requirements, model language, targeted reports, and presentations. For LID, the following products are particularly helpful:

- Stormwater Pollution Control Requirements: What Developers, Builders and Project Applicants Need to Know (Fact Sheet) http://www.scvurppp-w2k.com/pdfs/0506/C3%20flyer%20update%20120505.pdf
- Understanding Hurdles To Using Better Site Designs for Water Quality Protection (PowerPoint presentation: http://www.scvurppp-w2k.com/project_reports_fy0304/Hurdles.pdf)
- Addressing Fire Department and Public Safety Concerns http://www.scvurppp-w2k.com/project_reports_fy0304/potential_hurdles_fire_dept_100803.pdf
- Developments Protecting Water Quality: A Guidebook of Site Design Examples http://www.scvurppp-w2k.com/permit_c3_docs/SCVURPPP_Site_Design_Manual.pdf
- Applicability of New C.3 Provisions – Development Flow Chart http://www.scvurppp-w2k.com/project_reports_fy0304/Stormwater_Requirements_Checklist.pdf
- Site Design Guidance for Review of Local Codes and Standards http://www.scvurppp-w2k.com/pdfs/dvlpmnt_plcs/report/III_Conc_Conflicts_and_Rcmdns.PDF

Contra Costa Clean Water Program (CCCWP)

The Contra Costa Clean Water Program (www.cccleanwater.org) was formed by representatives of Contra Costa County, nineteen of its incorporated cities, and the Contra Costa County Flood Control and Water Conservation District. The CCCWP strives to eliminate stormwater pollution through public education, inspection and enforcement activities as well as outreach to industrial dischargers, residents and businesses. The CCCWP members are responsible for implementing the requirements of a municipal stormwater permit issued by the San Francisco Bay Regional Water Quality Control Board.

CCCWP has emerged as a leader in intergration of LID into the land development process. For LID, the following products are particularly helpful:

- Stormwater Control Plans and the Development Review Process (PowerPoint Presentation: http://www.cccleanwater.org/Publications/Oct06Workshop/SWControlPlans&DevReviewProcess.ppt)
- Contra Costa Approach (I): Experience So Far Using LID to Implement Stormwater Treatment Requirements (PowerPoint Presentation: http://www.cccleanwater.org/Publications/StormCon-5-06/5-ContraCostaApproach-I-Dalziel-Cloak.ppt)

- Sizing Integrated Management Practices Sizing Calculator – this model supports site designers in choosing and sizing LID techniques http://www.cccleanwater.org/new-developmentc3/stormwater-c3-guidebook/, See Appendix I

Alameda Countywide Clean Water Program (ACCWP)

Like other stormwater programs, the Alameda Countywide Clean Water Program (ACCWP, http://www.cleanwaterprogram.org/indexFlash.htm) has been active in developing information on meeting the C.3 provisions for new development and redevelopment. For LID, ACCWP has addressed one of the thornier issues related to both structural and non-structural BMPs—maintenance. The following templates have been developed and are applicable to any stormwater program.

- How to Use the Templates http://www.cleanwaterprogram.org/uploads/6.0%20Template%20Intro%20FINAL.pdf
- Vegetated Swale Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.1%20Veg%20Swale%20template%20FINAL.doc
- Vegetated Buffer Strip Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.2%20Buffer%20Strip%20template%20FINAL.doc
- Tree Well Filter Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.3%20Tree%20well%20filter%20template%20FINAL.doc
- Media Filter Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.4%20media%20filter%20template%20FINAL.doc
- Flow-Through Planter Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.5%20flo-thru%20plntr%20template%20FINAL.doc
- Bioretention Area Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.6%20Bioretention%20Area%20template%20FINAL.doc
- Infiltration Trench Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.7%20Infiltration%20Trench%20template%20FINAL.doc
- Extended Detention Basin Maintenance Plan Template http://www.cleanwaterprogram.org/uploads/6.8%20Detention%20Plan%20template%20FINAL.doc

Emeryville is a member of ACCWP and is recognized nationally as a leader in ultra-urban LID. In 2003, the City obtained a grant to develop "Guidelines for Dense, Green Development" (http://www.ci.emeryville.ca.us/planning/pdf/stormwater_guidelines.pdf). Emeryville faces a built environment that appears to preclude many LID techniques, including clay soils, legacy contaminants, and few green spaces. However, the City used the research behind the guidelines, the planning process, a BMP sizing spreadsheet, and code changes to institute reform. Note that the City did not only focus on new development and redevelopment, but also looked to the city's infrastructure for opportunities.

2.4 REGULATIONS GOVERNING NEW AND REDEVELOPMENT IN CALIFORNIA

2.4.1 Background

California has been delegated the authority to develop and administer Clean Water Act programs. Because the State's landscape varies dramatically, the responsibility has been divided among nine regional water quality control boards (RWQCBs). The State Water Resources Control Board (SWRCB) is the agency that oversees the nine regional boards. Under the SWRCB, each RWQCB acts as a semi-autonomous water quality agency. Under the State Porter-Cologne Water Quality Act (Porter-Cologne), each RWQCB is required to develop its own Basin Plan that contains water quality objectives and criteria for the region. The RWQCBs must use their judgment to determine water quality objectives that provide for "reasonable protection of beneficial uses and the prevention of nuisance." Within their Basin Plans, the RWQCBs must also specify plans for meeting the objectives, which include actions to be taken, a timeline for proposed actions, and a plan for evaluating success with achieving the objectives.

The State Water Quality Control Board and the nine RWQCBs have begun work on a number of LID initiatives[10] including:

- Requiring use of LID through site-specific and general permits
- Advocacy and outreach to local governments through the Water Board's Training Academy and regional workshops
- Research on incorporating LID language into Standard Urban Storm Water Mitigation Plan (SUSMP) requirements
- Funding of LID-related projects through consolidated grants program
- Funding through CWA 319 funds to support research on the applicability of the Impervious Surface Analysis Tool (ISAT) for land use planners and for the California Water and Land Use partnership (CaWaLUP) through the Center for Water and Land Use at U.C. Davis Extension

2.4.2 California Regulations

The integration of LID into local development codes will not occur in a regulatory vacuum. As localities draft land development codes, there are many, often competing, objectives involved with each and every parcel. Stakeholders interested in economic development, traffic, neighborhood preservation, housing, and equity, are among many players who shape decisions both at the larger policy level and during individual approval processes. As such, new requirements for stormwater management will enter an already complex regulatory environment, and California is no exception. In fact, there are several legal and policy issues unique to California that must be considered if LID is to be successfully integrated into State and local land development codes.

Stormwater Construction General Permit

The Construction General Permit is issued by the State Water Resources Control Board (SWRCB) and regulates stormwater discharges from construction activities (new development and redevelopment) at sites that disturb one or more acres. All construction projects in the state meeting the size criterion must submit a notice of intent to the RWQCB to obtain coverage under the permit. NOI submission requires development of a stormwater pollution prevention plan (SWPPP) that specifies how stormwater and

[10] SWRCB. 2003. *Low Impact Development - Sustainable Storm Water Management*. http://www.waterboards.ca.gov/lid/index.html. Accessed October 18, 2007.

pollutants will be managed during and after construction. A revised Construction General Permit has been proposed but is not yet approved. The following are features of the draft permit:

The permit seeks to limit hydromodification impacts that can adversely affect downstream channels and habitat. Specifically, for all projects disturbing one acre or more, the permit requires that the post-development volume of runoff from impervious surfaces approximates the pre-project runoff volume. Projects that disturb more than two acres have additional requirements to (1) preserve post-construction drainage divides and (2) maintain or extend pre-project time of concentration. Projects that disturb more than 50 acres must (1) preserve pre-construction drainage patterns by distributing their non-structural and structural controls within all drainage areas serving first order streams or larger and (2) maintain or extend pre-project time of concentration.

Applicants for coverage under the permit are required to submit a map and worksheets that demonstrate compliance with the above requirements. Detailed instructions are provided for calculating the volume of runoff that needs to be managed (or more sophisticated watershed models can be used).

LID is specifically incorporated into the draft permit in that it offers volume credits for the following types of nonstructural practices:

- Tree canopy cover
- Downspout disconnections
- Impervious area disconnection
- Vegetated swales
- Permeable pavers

The Construction General Permit is an important tool for stormwater management and LID promotion because it covers the entire state, whereas municipal stormwater regulations only apply to municipalities with populations greater than 10,000, small communities located within major metropolitan areas, and towns and cities specifically identified by the State based on projected growth rate or special water quality concerns.

Municipal Stormwater Permits

The Regional Water Quality Control Boards have issued permits to large, medium, and small municipalities throughout California to develop and implement multi-faceted stormwater management programs. Many of these programs, particularly those in large metropolitan areas, have been in place since the early 1990s. One of the main components of stormwater management programs is to regulate stormwater impacts from new development. Municipalities accomplish this by setting minimum runoff control and treatment requirements and reviewing and approving development plans that specify appropriate stormwater best management practices (BMPs).

On October 5, 2000, the SWRCB adopted Order WQ 2000-11, a precedential decision concerning the use of Standard Urban Storm Water Mitigation Plans (SUSMP) [11] in MS4 permits for new development and significant redevelopment projects. The SWRCB found that the SUSMP standards, which essentially require that urban runoff generated by 85 percent of storm events from specific development categories be infiltrated or treated, reflected the MEP standard. The SUSMP requirements were initially adopted by the Los Angeles RWQCB to require treatment controls for new and significant redevelopment projects. Because of the precedent set by Order WQ 2000-11, the RWQCBs' MS4 permits must be consistent with applicable portions of the State Board's decision and include SUSMP requirements. A statewide policy

[11] The term SUSMP is used by the Los Angeles and San Diego Regional Water Boards, but other Boards have adopted different terms for the new development requirements (such as Water Quality Management Plans, Development Standards, or Stormwater Quality Urban Implementation Plans).

memorandum (dated December 26, 2000) interprets the Order to provide broad discretion to RWQCBs and identifies potential future areas for inclusion in SUSMPs and the types of evidence and findings necessary. Such areas include ministerial projects, projects in environmentally sensitive areas, and water quality design criteria for retail gasoline outlets. Because each RWQCB has discretion to interpret and modify the requirements in the State Board order, each permit can have slightly different SUSMP requirements.

A number of RWQCBs have explicitly required the preferential use of LID to manage stormwater. The following are examples of LID provisions from recent permits or draft permits:

Los Angeles Municipal Stormwater Permit

The Los Angeles Municipal Stormwater Permit (Order 01-182, NPDES Permit # CAS004001) specifies that development projects are required to

- Maximize the percentage of pervious surfaces to allow percolation of stormwater into the ground
- Minimize the quantity of stormwater directed to impervious surfaces and the MS4
- Minimize pollution emanating from parking lots through the use of appropriate Treatment Control BMPs and good housekeeping practices
- Properly design and maintain Treatment Control BMPs in a manner that does not promote the breeding of vectors
- Provide for appropriate permanent measures to reduce stormwater pollutant loads in stormwater from the development site

The permit requires control of the post-development peak stormwater runoff discharge rates, velocities, and duration (peak flow control) in natural drainage systems that mimic pre-development hydrology to prevent accelerated stream erosion and to protect stream habitat.

Under SUSMP provisions, single-family hillside homes are required to:

- Conserve natural areas
- Protect slopes and channels
- Provide storm drain system stenciling and signage
- Divert roof runoff to vegetated areas before discharge unless the diversion would result in slope instability
- Direct surface flow to vegetated areas before discharge unless the diversion would result in slope instability

SUSMP requirements apply to sites that discharge to an Environmentally Sensitive Area (ESA), create 2,500 square feet or more of impervious surface area, and discharge stormwater that is likely to impact a sensitive biological species or habitat.

The permit allows municipalities to establish alternative compliance programs that offer participation in regional or sub-regional stormwater mitigation projects for development sites that receive a waiver for impracticability in meeting the performance requirements.

San Diego Municipal Stormwater Permit

The San Diego Municipal Stormwater Permit (Order No. R9-2007-0001, NPDES No. CAS0108758) specifies that municipalities develop requirements for all development projects that include LID BMPs where feasible that "maximize infiltration, provide retention, slow runoff, minimize impervious footprint, direct runoff from impervious areas into landscaping, and construct impervious surfaces to minimum

widths necessary." There is also a requirement to establish or maintain buffer zones for natural waterbodies, where feasible. Where buffer zones are infeasible, project proponents are required to implement other buffers such as trees, access restrictions, etc., where feasible.

The permit further specifies LID BMP requirements to collectively minimize directly connected impervious areas and promote infiltration at Priority Development Projects[12] as follows:

- For Priority Development Projects with landscaped or other pervious areas, drain a portion of impervious areas (rooftops, parking lots, sidewalks, walkways, patios, etc) into pervious areas prior to discharge to the MS4. The amount of runoff from impervious areas that is to drain to pervious areas shall correspond with the total capacity of the project's pervious areas to infiltrate or treat runoff, taking into consideration the pervious areas' soil conditions, slope, and other pertinent factors.
- For Priority Development Projects with landscaped or other pervious areas, properly design and construct the pervious areas to effectively receive and infiltrate or treat runoff from impervious areas, taking into consideration the pervious areas' soil conditions, slope, and other pertinent factors.
- For Priority Development Projects with low traffic areas and appropriate soil conditions, construct a portion of walkways, trails, overflow parking lots, alleys, or other low-traffic areas with permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials.

The permit specifies other LID BMPs to be implemented at all Priority Development Projects where applicable and feasible:

- Conserve natural areas, including existing trees, other vegetation, and soils
- Construct streets, sidewalks, or parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised
- Minimize the impervious footprint of the project
- Minimize soil compaction
- Minimize disturbances to natural drainages (e.g., natural swales, topographic depressions, etc.)

Municipalities must update SUSMP BMP requirements to add LID and source control BMPs (including siting, design, and maintenance criteria) and to define minimum requirements to maximize the use of LID practices and principles.

Restrictions are set forth for infiltration of runoff from areas that generate high levels of pollutants to protect groundwater. Specifically, this entails pretreatment (e.g., sedimentation, filtration) for infiltration BMPs, diversion of polluted dry weather flows, a minimum distance from seasonally high groundwater table, a minimum horizontal distance from wells, and restrictions on land uses that can drain to infiltration

[12] Priority Development Projects include housing subdivisions of 10 or more dwelling units, commercial developments and developments of heavy industry greater than one acre, automotive repair shops, restaurants, all hillside development greater than 5,000 square feet, ESAs, parking lots 5,000 square feet or larger or with 15 or more parking spaces and potentially exposed to urban runoff, streets, roads, highways, freeways, and retail gasoline outlets. Priority Development Projects also include those redevelopment projects that create, add, or replace at least 5,000 square feet of impervious surfaces on an already developed site that falls under the project categories or locations listed previously. Within three years of adoption, Priority Development Projects will also include all other pollutant generating projects that result in the disturbance of one acre or more of land.

BMPs (e.g., industrial or light industrial activity, high vehicular traffic areas, automotive repair shops, car washes, fleet storage areas, nurseries).

Redevelopment projects that create, add or replace at least 5,000 square feet of impervious surfaces on an already developed site that falls under the Priority Development Project categories are subject to tiered requirements as follows:

- If redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not subject to SUSMP requirements, the numeric sizing criteria applies only to the addition and not to the entire redevelopment site.
- Where redevelopment results in an increase of more than fifty percent of the impervious surfaces of a previously existing development, the numeric sizing criteria applies to the entire development.

Waivers of numeric sizing criteria can be granted when all available BMPs have been considered and rejected as infeasible. Alternative compliance for waiver recipients can be allowed by contributing the cost savings to a storm water mitigation fund that can be used on projects to improve urban runoff quality within the watershed of the waived project.

Draft Ventura Stormwater Permit

The Draft Ventura Stormwater Permit sets overall goals for stormwater management at regulated development sites[13] as follows:

- Minimize the percentage of impervious surfaces on land developments to support the percolation and infiltration of storm water into the ground.
- Minimize pollutant loadings from impervious surfaces such as roof-tops, parking lots, and roadways through the use of properly designed, technically appropriate BMPs (including Source Control BMPs such as good housekeeping practices), Low Impact Development Strategies, and Treatment Control BMPs.

All regulated projects are required to integrate LID principles into project design. LID strategies are required to be the first BMPs considered for a development site, followed by integrated water resources management strategies and multi-benefit landscape features, all of which contribute to the overall goals of LID. The least preferred BMP type is modular/proprietary treatment control BMPs.

The draft permit requires that all new and redevelopment projects reduce “the percentage of Effective Impervious Area (EIA) to less than 5 percent of total project area.” Impervious surfaces may be rendered "ineffective" if the storm water runoff is

- Drained into a vegetated cell, over a vegetated surface, or through a vegetated swale, having soil characteristics either as native material or amended medium using approved soil engineering techniques; or

[13] Projects required to meet new development standards include all development projects equal to 1 acre or greater of disturbed area; industrial parks, commercial strip malls, retail gasoline outlets, restaurants, streets, roads, highways, freeway construction, and automotive service facilities with 5,000 square feet or more of surface area; parking lots with 5,000 square feet or more of surface area or with 25 or more parking spaces; redevelopment that results in the creation or addition or replacement of 5,000 square feet or more of impervious surface area on an already developed site on development categories listed previously; projects located in or directly adjacent to, or discharging directly to an Environmentally Sensitive Area (ESA), where the development will discharge storm water runoff that is likely to impact a sensitive biological species or habitat or will create 2,500 square feet or more of impervious surface area; and single-family hillside homes.

- Collected and stored for beneficial use such as irrigation, or other reuse purpose; or
- Discharged into an infiltration trench.

Redevelopment requirements are based on the extent to which redevelopment activities[14] alter the site, as follows:

- Where redevelopment results in an alteration to more than fifty percent of impervious surfaces of a previously existing development, and the existing development was not subject to post development storm water quality control requirements, the entire project must be mitigated.
- Where redevelopment results in an alteration to less than fifty percent of impervious surfaces of a previously existing development, and the existing development was not subject to post development storm water quality control requirements, only the alteration must be mitigated, and not the entire development.

Local jurisdictions can develop Redevelopment Project Area Master Plans (RPAMPs) for redevelopment projects within redevelopment project areas[15] to set unique requirements to balance water quality protection with the needs for adequate housing, population growth, public transportation and management, land recycling, and urban revitalization. Goals for hydromodification control are to prevent accelerated downstream erosion and to protect stream habitat in natural drainage systems. The permit specifies that a project's pre-development storm water runoff flow rates and durations be maintained based on a stream's Erosion Potential. Controls may include on-site, regional, or subregional hydromodification control BMPs, LID strategies, or stream restoration measures, with preference given to LID strategies and hydromodification control BMPs. A hydromodification control study is underway to determine an appropriate hydromodification management plan for the region. Until that plan is complete, projects under 50 acres are required to match within 1 percent the 2-year, 24-hour pre-development hydrograph and projects larger than 50 acres are required to implement a Hydromodification Analysis Study.

Local jurisdictions can establish a regional or sub-regional storm water mitigation program to substitute in part or wholly for on-site post-construction requirements. Conditions for the mitigation program are that the projects result in equivalent or improved storm water quality, protect stream habitat, are fiscally sustainable and have secure funding, promote cooperative problem solving by diverse interests, and be completed in four years or less including the construction and start-up of treatment facilities. Local jurisdictions can also set up mitigation funding to fund regional or subregional solutions to stormwater pollution where a waiver for impracticability is granted, funds become available, off-site mitigation is required because of loss of environmental habitat, or where an existing water resources management plan exists that has an equivalent or improved strategy for stormwater pollution mitigation.

Local jurisdictions are required to provide outreach to stakeholders and develop a LID technical guidance section for the regional stormwater guidance manual, which includes objectives and specifications for integration of LID strategies, including LID credits.

Draft San Francisco Bay Area Municipal Regional Permit

Provision C.3 of the Draft Municipal Regional Permit for the San Francisco Bay Region (RWQCB 2) requires that all new development and redevelopment projects encourage the inclusion of the following

[14] Routine maintenance activities, emergency redevelopment activities required to protect public health and safety, and existing single-family structures that do not create, add, or replace 10,000 square feet of impervious area are exempted from redevelopment requirements.

[15] Redevelopment project areas include city center areas, historic district areas, brownfield areas, infill development areas, and urban transit villages.

LID-related measures: minimizing land disturbance and impervious surfaces (especially parking lots); clustering of structures and pavement; disconnecting roof downspouts; use of micro-detention, including distributed landscape detention; preservation of open space; protection and/or restoration of riparian areas and wetlands as project amenities.

New development and redevelopment projects that create and/or replace 10,000 square feet or more of impervious surface are considered "regulated projects" and are subject to post-construction stormwater management requirements. This includes commercial, industrial, residential developments as well as road and paved trail projects, with some exclusions. Starting July 1, 2010, the 10,000 square foot threshold will lowered to 5,000 square feet.

For redevelopment projects where more than 50 percent of the impervious surface of a previously existing development is altered, the entire project, consisting of all existing, new, and/or replaced impervious surfaces, must be included in the treatment system design. Where less than 50 percent of the impervious surface is altered, only the new and/or replaced impervious surface of the project must be included in the treatment system design.

Projects that meet EPA's Brownfield Sites definition, low-income and senior citizen housing developments, and Transit-Oriented Development projects that minimize the new or replaced impervious surface onsite can provide alternative compliance by installing, operating and maintaining equivalent offsite treatment at an off-site project in the same watershed or contributing equivalent funds to a regional project, to be completed within 3 years after the end of construction.

Regulated projects are required to implement the following LID measures:

- Install landscaping that minimizes irrigation and runoff, promotes surface infiltration, and minimizes the use of pesticides and fertilizers.
- Conserve natural areas, to the extent feasible, including existing trees, other vegetation, and soils.
- Minimize the impervious footprint.
- Minimize disturbances to natural drainages.
- For regulated projects with landscaped or other pervious areas, drain a portion of impervious areas into pervious areas before discharging to the storm drain and properly design and construct pervious areas to effectively receive and infiltrate or treat runoff from impervious areas, taking into consideration the pervious areas' soil conditions, slope and other pertinent factors.
- For regulated projects with low traffic areas and appropriate soil conditions, construct a portion of walkways, trails, overflow parking lots, alleys, or other low-traffic areas with permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials.

Regulated projects are required to select stormwater treatment systems in the following order of preference:

- Stormwater treatment systems that reduce runoff, store stormwater for beneficial reuse, and enhance infiltration to the extent that is practical and safe.
- Multi-benefit natural feature stormwater treatment systems, such as landscape-based bioretention systems, vegetated swales, tree wells, planter boxes, and green roofs.
- Prefabricated and/or proprietary stormwater treatment systems.

The permit stipulates that stormwater discharges from hydromodification projects, which create and/or replace one acre or more of impervious surface, "shall not cause an increase in the erosion potential of the receiving stream over the pre-project (existing) condition. Increases in runoff flow and volume shall be managed so that post-project runoff shall not exceed estimated pre-project rates and durations, where such

increased flow and/or volume is likely to cause increased potential for erosion of creek beds and banks, silt pollutant generation, or other adverse impacts on beneficial uses due to increased erosive force." Hydromodification controls include onsite, regional, and instream controls and measures.

Single-family home projects that create and/or replace 5,000 square feet or more of impervious surface are required to implement one or more of the following LID-related BMPs:

- Diverting roof runoff to vegetated areas before discharge to storm drain.
- Directing paved surface runoff flow to vegetated areas before discharge to storm drain.
- Installing driveways, patios and walkways with pervious material such as pervious concrete or pavers.

The permit requires that groundwater be protected through site evaluation and source control measures when infiltration practices are used. Infiltration devices are prohibited unless pretreatment is used in industrial and light industrial applications, areas subject to high vehicular traffic, automotive repair shops; car washes, fleet storage areas, nurseries, and other land uses that pose a high threat to water quality.

The permit requires regulated municipal permittees to update their General Plans to integrate water quality and watershed protection with water supply, flood control, habitat protection groundwater recharge, and other sustainable development principles and policies.

City of Salinas MS4 Permit

The City of Salinas MS4 Permit (Order R3-2004-0135, NPDES Permit # CA0049981) was issued by the Central Coast RWQCB in 2004. The permit includes provisions that, though not called low impact development, are intended to achieve results similar to low impact development requirements. Relevant provisions include a requirement to incorporate water quality and watershed protection principles into planning procedures and policies. The permit defines such procedures/policies as the General Plan or equivalent plans. The identified goal is "to direct land use decisions and require implementation of consistent water quality protection measures for all development projects."

The permit specifies that watershed protection principles and policies consider:

- Minimizing the amount of impervious surfaces and directly connected impervious surfaces in areas of new development and redevelopment
- Using on-site infiltration of runoff in areas with appropriate soils where there is no threat to groundwater quality
- Preserving and creating/restoring riparian corridors, wetlands, buffer zones, and other areas that provide important water quality benefits
- Limiting disturbance of natural waterbodies and natural drainage systems
- Requiring developers to prepare and submit studies analyzing pre- and post-project pollutant loads and flows resulting from projected future development
- Requiring incorporation of structural and non-structural BMPs to mitigate the projected increases in pollutant loads in runoff

The permit also specifies that restrictions be in place for infiltration BMPs to ensure that groundwater quality standards are not violated.

Waivers can be granted on a project-by-project basis for infeasibility. As specified by the order, Salinas "may propose a waiver program that would require any developers receiving waivers to transfer the savings in cost, as determined by the Permittee, to a storm water mitigation fund" subject to RWQCB approval. Funds are to be used for urban runoff quality improvement projects in the same watershed as

the waived project. Waivers can only be granted "when all appropriate structural treatment BMPs have been considered and rejected as infeasible."

The permit also requires Salinas to provide a description of necessary modifications to existing codes and ordinances and an implementation schedule for these modifications.

General Plans

General Plans (required under Government Code section 65300 *et seq*) were first introduced in the 1920's to plan and coordinate development. Like other areas of the country, the General Plan orchestrates local government Departments, their budgets and community goals, and is implemented by the zoning code and subdivision regulations. In California, State law mandates several required elements: Land Use, Circulation, Housing, Conservation (including Air and Water Quality), Open Space, Noise and Safety. Cities may also include other elements, such as Economic Development. In addition to required elements, the State required study, identification and presentation of detailed information, for example, the allowable uses within zoning codes and land subject to flooding. In 1971, a consistency requirement strengthened the elements within General Plans; development and zoning amendment need to be consistent with the General Plan. Thus, legal decisions affecting growth and development often hinge on the content and exact wording contained within General Plans.

Cities often adopt "Specific Plans" within the General Plan, which act like a special zoning code for a specific area, such as a Downtown Plan or a Master Planned Community.

All General Plans must comply with State law, and be updated as State laws are updated or revised. Finally, General Plans must go through a rigorous review under the California Environmental Quality Act.

Specific Area Plans

California, like other areas around the country, is addressing the shortcomings of conventional zoning and the associated environmental impacts. Successfully addressing impacts tends to occur not from adjusting parameters within codes, but with wholesale change to the alignment of public and private space within districts, such as downtowns, Master Plans, and corridors. Specific area plans are essentially "overlay" zones that orchestrate the relationships among sites, infrastructure, open space, drainage, and uses. Specific area plans have been increasingly used to introduce use mix (and hence reduce trip-making), encourage walkability, redevelop older towns and cities, and develop master-planned communities.

California Environmental Quality Act

California Environmental Quality Act (CEQA) analysis is a major part of the development landscape in California. The purpose of CEQA is to fully vet environmental impacts related to land development decisions and determine whether environmentally preferred options exist. CEQA is perhaps best presented as a step-wise process:

Step 1: The Application of CEQA – CEQA applies to "projects," which are defined as actions approved at the discretion of a local government (such as issuing a permit). In some instances the discretionary action can involve very small projects, and in others, large ministerial projects need to no CEQA review at all. There is a list of exemptions, such as demolition permits, small infill sites, and affordable housing projects in urban areas. In addition, there are categorical exemptions, such as projects less than 10,000 square feet, and projects of three homes or fewer.

Step 2: The Initial Study – If CEQA applies, an initial study is undertaken to determine whether there will be "significant environmental effects. This is among the most litigated parts of the process and is loosely defined. For stormwater, note that thresholds and checklists have been turned down in

Courts for determining significance, even as checklists and thresholds gain in popularity for stormwater management programs.

Step 2a: Mitigated Negative Declaration – If the environmental impacts are easily identified and mitigated, a developer is often asked to mitigate those impacts up front, in essence reducing the impacts below the "significance" threshold that triggers further CEQA review. LID requirements may come into play for this step in CEQA.

Step 3: The Environmental Impact Report (EIR) – If the Initial Study shows the potential for significant impacts, an EIR must be prepared. EIRs are at the "public information" core of CEQA and can be far-ranging in detail and scope. Because EIRs can take months to prepare and significant up-front cost, there is some evidence that the process drives smaller projects and players out of contention. In presenting impacts to the public, the EIR must present the following:

- Significant environmental effects
- Unavoidable environmental effects
- Significant irreversible environmental change
- Alternatives to the project (for example, an alternative design or a "no build: alternative)
- Cumulative Impacts arising in combination with other projects
- Growth-inducing impacts
- Mitigation measures that will be adopted

Step 4: Local Government Action – Even with significant impacts a local government may approve a projects. However, the government may also deny the project, approve one of the alternatives, or specify mitigation measures.

At the State level, the Office of Planning and Research issues CEQA guidelines, which, despite the name, are mandatory. They spell out rules on process and content. For stormwater, the new NPDES regulations, as well as emerging research on LID and BMPs, will likely enter into State language on data collection and analysis, in particular for General Plans.

CEQA is also recognized for what it does not do. Regional (or watershed) cooperation is not among the outcomes sought. Alternatives analyses are typically not informative, and there is little direction (other than often contradictory Court decisions) that helps streamline CEQA. Moreover, the data most related to watershed-wide impacts (analysis of cumulative and growth-inducing impacts) are the weakest elements within CEQA review.

Subdivision Map Act

The original intent of the Subdivision Map Act was to denote clear title to plots of land. Over the years, the Act was used by land speculators who would produce older maps to claim rights to subdivision as land development rules tightened. However, the strongest attribute of the Act is the establishment of fees and exactions. The ability to impose impact fees, require dedication of land, and provision of infrastructure have their roots in the Act; LID requirements may need to be framed within this exaction process.

Exactions in California have been at the center of legal activity for decades, and will shape effective LID requirements, in particular the dedication of land for infiltration or stormwater management. In a nutshell, the cases have been:

Erlich v. Culver City – This case tried to resolve a myriad of loosely related decisions on impact fees. In the end, tests were established for different project types. A "reasonable relationship" test must be met when exactions are required of all developers as a matter of broad policy. The stricter rough proportionality/essential nexus test is to be used with single developers.

Nollan v. California Coastal Commission – This Supreme Court case established the "direct nexus" test between a project and the exaction required. (The same year, AB 1600 was passed, which requires local governments to identify how fees and exactions are to be used). "Nexus studies" are now a routine part of the development approval process; for supra-site level LID, measuring the wider stormwater impacts and how they are addressed beyond site level impacts will likely loom large.

Dolan v. Tigard – This Supreme Court Case decision builds on the Nollan case, and specifies that not only does a local government need to show a nexus, but also the final exaction must have a "rough proportionality" to the project. This will likely come into play with CEQA analyses that show induced growth, and LID assignments that might be required outside the boundaries of the project (the logic will follow the process of determining developer exactions for an off-site Highway interchange *and* the roads within the boundaries of a project).

The end result of all these cases strengthens the role of the General Plan. Thus, if the State requires LID via General Plans, the reasonable relationship test must be met. However, cities and Counties that do not include LID in General Plans may need to perform a higher level of analysis to link exactions and project review.

The use of maps in planning and zoning is widespread but has legal bearing in decisions on subdividing land. Developers often produce a "tentative map" to show lots, improvements, and response to initial feedback from regulators Local governments at this stage have leverage over site design, land conservation, and other matters. Developers will often seek a "vested tentative map," which grants entitlements for a period of time. Once approvals are accepted, the developer produces a final map. Note that localities can deny maps based on incompatibility with the General Plan, physical unsuitability of the site, or environmental damage.

Affordable Housing

Affordable housing in California is not only the grist of national headlines but is now firmly established in State law. Cities are required to develop density bonus programs for affordable housing and provision of second units. The nexus between affordable housing and environmental protection is also well recognized. California's 2003 "Environmental Goals and Policy Report[16]" clearly links low density housing, sprawl, and environmental degradation. The city of San Jose has established policies that essentially recognize certain affordable housing projects as stormwater BMPs. The logic behind this is that if affordable housing is not provided on a small footprint near jobs and services, the demand will exert itself elsewhere in the watershed, most likely on a much larger footprint and on land providing watershed services.

This linkage is likely to emerge in LID policymaking in several ways. First, laws allowing second units on a property will run squarely into strict on-site LID requirements, especially if local rules cap impervious coverage in areas with traditionally small home sites. Opponents of the new stormwater rules are already raising affordable housing shortages as the primary consequence of potential policies. However, a second linkage will emerge as variations of the San Jose policy. If affordable and workforce housing are primary drivers of imperviousness, then "housing as a low impact strategy" will emerge as a powerful practice. The key will be quantifying the relationship. Finally, in largely built-out areas, particularly in coastal California, where improving stormwater will primarily arise from retrofit, any successful LID policy may need to pull together other programs to help underwrite on-site BMPs, in particular for areas struggling to attract redevelopment interest under current rules.

[16] California Office of Planning and Research. 2003. *Governor's Environmental Goals and Policy Report*. http://opr.ca.gov/planning/publications/EGPR--11-10-03.pdf. Updated November 10, 2003. Accessed October 18, 2007.

Roadways

According to the Center for Watershed Protection, "habitat for cars" comprises more than half of all impervious surface coverage. Overly wide road standards (sometimes referred to as "geometric standards) are a culprit. In California, road standards tend to follow the Institute for Transportation Engineers guidebooks and standards established by local Fire Protection Districts.

Advocates for smart growth, climate change, and watershed health agree that road standards need to change for a reduced impact. Work over the past decade has revealed the impetus for over-engineered roadways: (1) national standards provide local governments with a tested and low-risk model, (2) emergency responders direct standards to maximize access for equipment and maneuverability, (3) a sprawling pattern dictates the hierarchical systems of increasingly wide roadways to funnel traffic (as opposed to a grid, which disperses traffic), even though developers provide local roads, and (4) seismic requirements for highly engineered roadbeds and shoulders.

The October 2007 California fires and earthquakes highlighted the role of roads and access; thus discussions on lower-impact roads in rural areas might not gain traction. This may, however, strengthen the argument for lesser road impact in areas inside the urban/wild interface. The U.S. Environmental Protection Agency's Smart Growth program recently awarded the Congress for New Urbanism a grant to address road widths and design nationwide because mandating new road geometry in legislation is not likely to succeed given the competing safety, community, and environmental goals. This will dovetail with previous work by the Sacramento-based Local Government Commission and the Sustainable Streets effort within the University of California-Irvine (UC Irvine). In addition, Caltrans is developing a "smart mobility" scorecard that will be used in future funding decisions, and researchers at UC Davis are working on a green streets initiative and, in cooperation with Caltrans, incorporation of trees into highway systems that can aid in stormwater mitigation.

Initial research from UC Irvine shows that the environmental street design discussion is bifurcated into two areas: (1) sustainable streets with an emphasis on stormwater, or (2) mobility and design. There is a need to shepherd the two into one effort to achieve both objectives.

3 Types of LID Requirements

There are a number of ways in which LID criteria can be incorporated into statewide, regional, or local stormwater requirements. Table 2 lists the different approaches and briefly describes advantages and disadvantages of each.

Table 2. Types of LID Criteria

Type	Advantages	Disadvantages
Uniform Performance Standards		
Uniform performance standards	Ease of administration	Insensitive to site constraints, unique conditions, and development context
Uniform performance standards with list of accepted BMPs	• Ease of administration • Certainty for planners/ developers	BMP lists may be outdated, in particular for emerging LID BMPs
Uniform performance standards with list of accepted BMPs and predetermined list of exemptions	• Ease of administration • Certainty for planners/ developers • Exemptions can be tailored	• BMP lists may be outdated • Exemption list may no include full range of constraints • Exemption process can be resource intensive • Potential for exemptions to become rule if not carefully crafted
Tiered Performance Standards		
Tiered criteria based on subwatersheds	• Criteria can be established based on pollutants/ development context of subwatershed • Can address flooding within the subwatershed	• Subwatershed mapping needs to be developed and supported by strong data collection program. • Subwatersheds may lie across several jurisdictions, which would require cooperation or uniform rules
Tiered criteria based on predetermined geographical areas	Criteria can be established within established geographical or jurisdictional boundaries	Rules established for a jurisdiction may not capture entire subwatershed
Tiered criteria based on development parameters: infill, new development, and redevelopment	Criteria can be targeted based on watershed function lost or designed to match BMPs to development contexts	May be seen as relaxing rules for one type of development
Tiered criteria based on economic development parameters	• Can be used to attract development to distressed areas (in particular where watershed benefits would be achieved via redevelopment) • Ease of administration where economic development areas are supported by existing programs • Can be used to attract investment for repairing infrastructure.	Some economic development districts lie in areas in most need of higher performance standards for volume or pollutant removal

Table 2. Types of LID Criteria

Type	Advantages	Disadvantages
With Supporting Credit System		
Hydrology criteria supported by credit manual	Credits can be advantageous for practices that are not easily measured or for which performance has not been established. Credits typically easier to administer than exemptions since they are front-loaded into the process.	Relief provided by credits may not be justified by analysis, paperwork or application fee. Credits may not apply to all development contexts and may result in uneven regulatory playing field. Small stormwater programs may not have resources to develop credit manual.
With Alternative Compliance Process		
Limited alternative compliance options with prescribed triggers and process for developing a "Finding of Impracticability"	• Alternative compliance is advantageous where there are numerous site constraints or varying landscape considerations • Alternative compliance programs can be used to fund district or regional BMPs • Alternative compliance programs can be written to support preferred practices where on-site BMPs are not practical	• The list of triggers may not encompass entire range of conditions or constraints • The process for "Finding of Impracticability" may be burdensome for smaller developers/sites • Widespread use can lead to lesser application of BMPs on individual sites
Case-by-case	Case-by-case application may be needed where a "Finding of Impracticability" or need is not apparent or where there are a number of constraints	Evaluation process is resource-intensive
With Exemptions		
Exemption process spelled out in regulations or technical manual	• Exemptions allow flexibility in *de minimis* situations • Exemption process can ease administration and add certainty	Widespread use of exemptions can erode the effectiveness of the BMP program
Case-by-case	Case-by-case assessment allows for closer examination of site conditions and considerations	Evaluation process is resource-intensive
Tied to Other Water Performance Standards and Programs (e.g., TMDLs, Anti-Degradation)		
LID criteria with reference to methodology for determining BMP performance required	Integrating Clean Water Act programs can make use of existing data and improve efficiency of administration	CWA programs have differing legal processes that may be challenged with integrated program requirements
LID criteria with monitoring and triggers	Monitoring results can tailor BMP response to specific pollutant reduction or elimination needs	• Monitoring results subject to challenge, which may extend process • May not be sensitive to upstream/downstream considerations (i.e. downstream permittees carry BMP responsibility for upstream loadings) • Response may need larger action than additional triggers for on-site BMPs

Table 2. Types of LID Criteria

Type	Advantages	Disadvantages
LID Criteria included in Technical Manual	• Only bare-boned ordinance, with reference to technical manual, needed • Technical manual can be a better vehicle for presenting information on size, type, and installation of BMPs that respond to wider variety of environmental pressures (such as habitat or land conservation) • Eliminates multiple manuals for different programs • Technical manuals can be written for a specific plan (e.g. downtown) to coordinate and integrate land development and BMP designs	More than one manual may be needed when there is a wide variety of environmental or development circumstances
LID criteria included in technical manual with levels of service (LOS)	• Setting LOS can help establish benchmarks within the program manual itself and assist in measuring results and reporting • LOS can either be environmental LOS or programmatic LOS (or both)	Benchmarks may be viewed as non-compliance triggers
Other		
Tied to other environmental performance standards and programs (e.g. greenhouse gas, energy, anti-sprawl)	• Best practices for other environmental programs offer watershed benefits (e.g., reduction of auto use) • Can help attract grant dollars for multi-objective programs	Ties to other mandates may be challenged as over-reaching in terms of achieving CWA compliance
Developed via inter-jurisdictional programs	• Can help avoid shifting development to areas with lesser standards and criteria • Coordination can allow better leveraging of resources • Many California jurisdictions have already formed regional alliances, thus models exist	• Smaller jurisdictions may be reluctant, in particular where larger jurisdictions have adopted stringent rules • May require development of unified land development regulations, which is time consuming • Administration requires frequent collaboration, which can be time-intensive

4 Options for State LID Statute Requirements

California has yet to implement a statewide policy governing LID or smart growth, though both regulatory and non-regulatory approaches can be used to promote LID implementation. (Non-regulatory approaches that build on existing initiatives are described in Appendix A.) In major metropolitan areas of the state, LID and smart growth policies are being incorporated into municipal stormwater permits; however, these requirements are not being applied to rapidly growing exurban areas. The Construction General Permit, currently undergoing revision, will apply to construction activities disturbing greater than one acre in all areas of the state and is expected to include a more progressive LID approach to stormwater management. Because California already has mechanisms in place or soon to be in place that require or encourage the use of LID, proposed state statute requirements should draw from these precedent approaches. A major benefit of a state statute for LID would be to provide consistency for how LID is addressed in stormwater Phase I communities, Phase II communities, and those areas not regulated under the municipal stormwater program.

Low impact development techniques and natural drainage are a logical first step for the design of any area planning. Care must be taken, however, in crafting regulatory language related to LID. Where regulations and performance standards are written exclusively for individual sites, the ability to credit the collective natural system can be lost, giving developers little incentive to use natural systems for multiple sites. Even where the regulations note that natural drainage should be given preference, the performance standards for individual parcels form the legal baseline. Likewise, the most effective water quality and runoff management program may be a shared system, not the additive effects of plot-level BMPs. Watershed planners and localities need to be given this option.

Any state statute requiring LID needs to be crafted with extensive stakeholder input, particularly from the Regional Water Quality Control Boards and regulated stormwater municipalities who have already done extensive work incorporating LID into permits and programs. The State should make every effort to avoid undermining progressive requirements already in place in some areas (particularly southern California and the Bay area) by setting performance standards that are less stringent than current requirements. On the other hand, the requirements should not be so stringent that smaller municipalities that have less experience with LID and stormwater management will have trouble implementing them. New legislation should balance water quality needs with existing and future capacity to implement LID requirements.

The following is a set of key concepts, including regulated projects, requirements, credits, waivers, and alternative compliance mechanisms, that a state statute on LID could address. It is important to note that this text is not intended to be statute language, per se, but it could serve as a foundation for a set of legal requirements that define minimum, progressive standards while allowing flexibility at regional and local levels to account for existing regulatory mechanisms and differing environmental conditions and management objectives. These recommendations are based on precedents from within California (described in Section 2.4) and from other states (a compendium of LID requirements from other states can be found in Appendix B).

4.1 Recommended Low Impact Development Requirements for California

A state statute on LID will likely need to address the following key concepts:

- **General Plans** – provide language on low impact development into the Land Use and Conservation Elements of General Plans
- **Specific Plans** – inserts language on establishing tiered design review for specific plans requiring an assessment and use, to the extent practicable, of natural drainage systems

- **Regulated projects** – defines the threshold for projects that need to address the LID requirements, including schools, universities, and other public facilities (i.e., no exemptions for non-traditional MS4s)
- **Requirements** – describes the requirements for LID statewide (will likely be further specified in NPDES permits or local regulations)
- **Stormwater credits** – provides the authority to issue credits that encourage better stormwater practices
- **Waivers** – provides the authority to waive requirements when certain conditions are met
- **Alternative compliance** – provides authority for innovative practices, in lieu of payments or mitigation
- **Definitions** – defines key terms

The key concepts above are further discussed below in the format of a hypothetical state statute. Each element is intended to encourage, facilitate, or require implementation of LID and is based on precedents from within California and from other states. Additional areas that might be included in an LID statute are penalties for noncompliance, enforcement, and regional variations.

4.1.1 General Plans

Local jurisdictions shall incorporate low impact development and natural drainage techniques into the Land Use and Land Conservation Elements of General Plans.

4.1.2 Specific Plans

Local jurisdictions shall amend procedures regulating the development of specific planning to include opportunities to incorporate and preserve natural drainage into the overall design of specific areas. This shall also apply to Master Plans.

4.1.3 Regulated Projects

Regulated development projects include (1) new development creating at least 5,000 square feet of total impervious surface area and (2) redevelopment that results in the creation, addition, or replacement of 5,000 square feet or more of impervious surface area on an already developed site, not including road resurfacing or repair projects.

Local jurisdictions shall have the authority to set a lower threshold of total impervious surface area to be more inclusive of sites that discharge to environmentally sensitive areas or impaired waterbodies, hillside sites, sites with a high likelihood of pollution generation, sites with highly erodible soils, or other areas requiring special protection from stormwater impacts.

4.1.4 Requirements

Regulated development projects shall be required to implement site design, source control, and stormwater treatment measures to control post-development stormwater volume and peak flows (stormwater discharge rate, velocity, and duration) to mimic pre-development hydrology, prevent accelerated stream erosion, protect stream habitat, and provide for the reuse of stormwater.

Source controls and low impact development techniques shall be the primary methods for managing post-construction stormwater on a development site. Additional stormwater detention, retention, and treatment practices shall be implemented as needed to manage excess stormwater to meet water quality and hydrologic goals.

Regulated development projects shall reduce the percentage of effective impervious area to less than five percent of total project area by draining stormwater into landscaped, pervious areas. The pervious areas shall be designed and constructed to effectively receive and infiltrate or treat runoff from impervious areas, taking into consideration the pervious areas' soil conditions, slopes, and other pertinent factors.

For redevelopment projects where the redevelopment results in an alteration to 50 percent or more of impervious surfaces of a previously existing development, the entire project, consisting of all existing, new, and/or replaced impervious surfaces, shall be required to meet these performance requirements.

For redevelopment projects where the redevelopment results in an alteration to less than 50 percent of impervious surfaces of a previously existing development, only the new and/or replaced impervious surface of the project shall be required to meet these performance requirements.

Note: an alternate requirement would be to require that redevelopment projects reduce impervious surface by 20 percent or provide water quality treatment of 20 percent of the site's imperviousness, or achieve a combination of both imperviousness reduction and water quality treatment equal to 20 percent.

4.1.5 Stormwater Credits

Local jurisdictions shall have the authority to reduce the required capture volume of stormwater retention practices by offering credits for low impact development techniques implemented on a development site that reduce total and effective impervious surface area and intercept, capture, infiltrate, evaporate, or reuse stormwater. Local jurisdictions that choose to employ a stormwater credit system shall develop and submit to the Regional Water Quality Control Board for approval a methodology for applying credits to stormwater management sizing calculations. The methodology shall include a procedure for verifying that low impact development techniques were implemented as described in the site design.

4.1.6 Waivers

Local jurisdictions shall have the authority to grant a waiver of the performance requirements on a project-by-project basis if a development site owner demonstrates that all available best management practices have been considered and rejected as infeasible due to site constraints. Local jurisdictions shall notify the Regional Water Quality Control Board within 60 days of granting a waiver for infeasibility. The notification shall include the evidence of infeasibility and the nature of the alternative compliance payment or activity to be implemented.

Alternative and Innovative Compliance

Local jurisdictions shall have the authority to establish joint low impact development and stormwater planning practices that can be shown to deliver superior protection to the applicable stormwater performance standards.

Payment in Lieu

Local jurisdictions shall have the authority to establish a regional or subregional stormwater management fund to pay for watershed projects that have stormwater benefits (e.g., regional stormwater management systems; riparian, wetland, or coastal restoration projects). Development site owners that have been granted waivers for infeasibility may be offered the option of a payment to this fund in lieu of meeting the performance requirements. The amount of this payment shall be determined by the local jurisdiction and shall be based on the estimated water quality and hydrologic impacts of stormwater discharges from the development site.

Mitigation Projects

Local jurisdictions shall have the authority to establish an alternative compliance program that offers development site owners who have received a waiver for infeasibility the option to participate in regional or sub-regional stormwater mitigation projects. Mitigation projects shall impact the same receiving water as the development site wherever possible and offer an equivalent level of environmental benefits.

4.2 DEFINITIONS

Best Management Practices – Methods, measures, or practices designed and selected to reduce or eliminate the discharge of pollutants to surface waters from point and nonpoint source discharges including storm water. BMPs include structural and nonstructural controls, and operation and maintenance procedures, which can be applied before, during, or after pollution-producing activities.

Effective Impervious Surface Area – The area of hardened surfaces that do not infiltrate stormwater and drain directly to a storm drain system, open channel, or natural stream.

Low Impact Development – A stormwater management strategy concerned with maintaining, mimicking or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives. It involves implementing small-scale, site design and landscape features that are distributed throughout a development site and result in the infiltration and treatment of runoff from impervious surfaces.

Regulated Development Projects – New development creating at least 5,000 square feet of total impervious surface area and (2) redevelopment that results in the creation, addition, or replacement of 5,000 square feet or more of impervious surface area on an already developed site, not including road resurfacing or repair projects.

Specific Area Plan – A specific area plan is a relatively detailed plan for the development of a particular part of a city (both new development and redevelopment), which may include a master environmental impact review.

Total Impervious Surface Area – The total area of hardened surfaces that do not infiltrate stormwater, including paved streets, sidewalks, parking lots, buildings, and roofed areas.

5 LID in Local Codes and Ordinances

5.1 OPTIONS FOR INCORPORATING LID

Many land use and development decisions take place at the local level, so managing the impacts of impervious cover first requires an understanding of the local codes and standards that direct the size and placement of hardscape. Land development codes tend to operate at both the site level and at the larger city or county scale. The larger scale codes can be found in subdivision regulations, geometric dimensions for streets, and general plans. In California, master plans and specific plans coordinate the "footprint" of both the public realm (streets, parks) and individual lots even when the entire site is carried out as one project.

At the site scale, zoning ordinances, landscape codes, and building codes direct a building's bulk dimensions, parking, placement, and landscaping. Parking codes merit special attention because parking looms as one of the larger features in the built environment. Parking may be included within individual zoning codes, within specific or master plans, or in a city-wide code.

Municipalities have a number of options for integrating LID and smart growth into codes and the development approval process. For example, they can choose to implement a voluntary or regulatory approach, or they can choose a hybrid program that incorporates both voluntary and required elements. Table 3 describes options for integrating LID into existing land development ordinances, including some advantages and disadvantages of each approach.

Table 3. Approaches for Integrating LID Into Local Codes and Ordinances

Approach	Advantages	Disadvantages
Voluntary Measures – The least rigid process for implementation is to establish voluntary guidelines.	Since some LID measures reduce costs, or have benefits that exceed conventional practices, developers and homeowners may gravitate to LID. Voluntary measures also have the benefits of allowing flexibility and creativity since prescribed practices are not in place. Because the practices are voluntary, developers do not have to worry about sanctions for improperly installed or maintained BMPs.	As implied by the name, adoption is voluntary, and may require extensive outreach and education of the benefits.
Incentives-Based Approach – Communities may adopt voluntary or regulatory LID practices that are accompanied by an incentives program.	Incentives can help introduce new practices, or help bridge costs where LID installations are higher (as compared to conventional practices). Incentives can also be offered to induce developer interest in neighborhoods targeted for redevelopment.	Departments would have to establish new funding streams, which can be a challenge.
LID Ordinance – Communities may adopt stand-alone LID ordinances.	Stand-alone ordinances are easy to draft and enact.	A separate code may be confusing because it may not consider (or even conflict with) similar regulations on stormwater performance criteria or landscaping codes. Developers and site designers must refer to multiple codes. If changes to the code are needed, improvements must go through the sometimes lengthy process of code change.

Table 3. Approaches for Integrating LID Into Local Codes and Ordinances

Approach	Advantages	Disadvantages
Stormwater Management Ordinance – May require or encourage LID as part of a stormwater management ordinance.	Phase II communities are adopting post-construction ordinances to fulfill MS4 permits. LID can be incorporated into these ordinances without having to create a separate ordinance. Stormwater management performance standards can be key to the implementation of LID.	Communities will still need to review and revise development codes to eliminate or minimize barriers to LID.
LID Ordinance with Reference to Design Manual – Many communities oversee site and district design through design manuals.	Design manuals can go into more detail on LID selection and sizing. Design manuals can also integrate several development objectives at once, for example, combining LID with transportation-oriented development, use mix and/or redevelopment. Established design guidelines may be readily adapted to integrate natural drainage and LID. Perhaps the biggest benefit is that any fine-tuning of a design guideline does not need to go through that same process as code change.	Guidelines can be resource and time intensive. Cities with a variety of landscapes, development formats, and terrain will likely need to develop several guidelines.
Rezoning to Match General Plan Updates or NPDES MS4 Permit Requirements – Some cities use the General Plan process to introduce new zoning and land development regulations.	Applying new zoning codes clearly denotes site design and construction parameters. Emerging NPDES permits with on-site or LID requirements require a coordinated change in General Plans and ordinances.	The rezoning kicks in only where a property is developed or redeveloped (as opposed to a building rehabilitation). New zoning code requirements on LID could result in many non-conforming properties. If new LID requirements are viewed as a downzoning, cities and counties will be faced with addressing these concerns.
Building Code Changes – Building code changes can also be modified to integrate LID practices.	This is an option in cities or counties without zoning. In addition, building code changes may be more easily passed than a zoning code overhaul. Where the minimum land disturbance triggers are not met with NPDES permitting, building code changes can be changes to trigger LID with building rehabilitation. Even where rezoning occurs, building code changes may be necessary for green roof and onsite storage (e.g., cisterns and vaults).	Building code changes may not cover site design. In addition, LID at the district scale would not be thoroughly addressed if only building codes are amended.
Overlay Zoning – Overlay zoning is an increasingly popular method of introducing new requirements. While some overlay codes supersede the underlying zoning, in many cases, the overlay zoning is an option.	Overlay zoning can be matched to Master Planned development and Specific Plans to overcome the disadvantages of older, conventional zoning codes. For LID, an overlay zone can match BMPs to specific stressors, TMDLs or restoration needs.	Where the overlay is an option, cities or counties may need to offer incentives to increase the chances that the overlay will be adopted.

Table 3. Approaches for Integrating LID Into Local Codes and Ordinances

Approach	Advantages	Disadvantages
Alternative Compliance – Alternative compliance (including "fee in-lieu-of" programs and waivers) are a universal feature of any land development code.	Alternative compliance recognizes the wide variety of environmental or development conditions. While infiltration is a key feature of LID, many areas are unsuitable for infiltration practices (e.g., where the water table is high or where legacy contaminants pose a risk). "Fee in-lieu-of programs" can be designed to address the highest priority stormwater or flooding problems first.	Widespread waivers of alternative compliance can undermine the original environmental program. Cities must be able to quantify the fee associated with in-lieu-of programs. Some programs are seen as a developer giveaway.
Credit System – Credits for LID are increasingly popular, especially for stormwater and drainage requirements.	Credits are often used to promote environmentally preferable practices. They can also be used where the water resource benefits are difficult to fully quantify (e.g., preventative BMPs and smart growth practices). Where financial incentives are unavailable, credits can be used since they often lower costs. Cities and counties can use credit systems to attract development to certain areas (depending on how the credit system is structured).	Credits tend to put pressure on quantification to ensure fairness and environmental compliance. Thus, the advantage of crediting practices that are difficult to quantify is reduced. Credit systems can be resource intensive and are difficult to rescind once practices become commonplace. Where localities set strict initial performance standards, a credit system can be viewed as "going backwards" since the performance standard is viewed as the starting point for all projects.

While it may seem that instituting LID performance standards into zoning codes is straightforward, reducing and eliminating excess impervious cover is typically a multi-stage effort. This is because established zoning and land development codes have been built over time with input from a variety of parties with an interest in zoning parameters. Municipalities undertaking code and ordinance changes to incorporate LID should tailor their approach to the local context, taking into consideration existing development patterns, watershed conditions, stakeholder input, and other factors that will affect the opportunities for BMP implementation. Table 4 describes changes to codes that are appropriate for different types of development in urban, suburban or edge, and rural settings.

Table 4. Code Changes for Different Development Types and Settings

Development Type	Urban Codes	Edge Codes	Rural Codes
New Development	In highly developed urban areas, new development is likely to install impervious cover in the last absorptive places, though lot sizes are likely to be small. Codes should look at the stormwater functions lost and whether there are "hotspot" issues related to legacy contaminants. In urban areas, combinations of structural techniques (vaults) and small scale distributed landscaping are emerging practices to balance stormwater handling and water conservation. Code amendments will need to balance structural/non-structural techniques. Green roof technology improvements are responding to the range of environmental conditions. In Southern California, there is fear that green roofs would require irrigation most of the year. Moreover increased roof weight can trigger additional seismic requirements.	On the edge, new development is likely to consist of Master Planned Communities that are urban in nature (i.e., high levels of trip-making, demand for mix of uses, school travel). Reducing the impacts of impervious surface will come from both community design and onsite practices. Where urban boundaries are not in place, there may be opportunities to tie open space proffers to stormwater management. For new development in edge and rural areas, street designs should be carefully addressed. Where the format is mainly urban, narrow connected streets will better support activities. Where the format is more rural in nature, fewer engineered factors (i.e., no sidewalks) will form design. Note that "Campus Zoning" is replacing office park zoning. While the new designs emphasize green features onsite, the transportation remains auto-dominant.	Many rural areas of California lie outside of NPDES regulations. Some new low impact designs reduce developer costs (less street infrastructure). This can assist in provision of affordable housing, but also may attract development from regulated areas. Currently, 10 to 20 acre ranchettes are emerging as a popular housing type. The environmental impacts are not well-defined, however there are rural design/code options to lessen those impacts (e.g., shared facilities for stables, RV parking on a smaller footprint). New development in rural areas is likely to undergo increased CEQA scrutiny, in particular for induced growth, cumulative impacts and transportation-related climate change.
Redevelopment	Redevelopment projects in urban areas are likely to be part of a specific plan. Reducing the impacts of replaced imperviousness thus will rely on coordination of hardscape and open spaces. There may be socioeconomic factors in addressing redevelopment via NPDES. The additional requirements may further depress development interest in certain neighborhoods, thus cities may need to combine stormwater control with economic incentives.	Redevelopment at the urban edge may consist of a mix of new development and redevelopment. Thus, reducing the effects of imperviousness may involve reviews of specific plans, corridor redevelopment planning, use of remaining natural drainage and onsite measures. Parking codes are likely to dominate discussions where auto-dominant landscapes are being retrofitted with pedestrian features.	Rural "smart growth" designs often focus on historic downtown areas, crossroads and corridors. Code changes will need to recognize the watershed benefits of compact design.

Table 4. Code Changes for Different Development Types and Settings

Development Type	Urban Codes	Edge Codes	Rural Codes
Infill	Like new development, infill may involve a net increase in impervious surface. In urban areas, the increasing size of infill housing and its character are the subject of code changes; the stormwater regulations may also fit in these discussions and might be used as a tool to negotiate better housing and landscape design. New stormwater regulations are likely to put pressure on the construction of second units, in particular in areas with smaller lot sizes.	Infill projects need to be assessed for proximity to existing centers to determine community design features. Like urban areas, the character of infill housing in older neighborhoods is entering code change discussions. Form-based codes were authorized in State law, and are being adopted. Their role in stormwater management is to lessen the impact of vacant properties (since reuse is made easier with flexible form). Likewise FBCs are typically part of a coordinated district, which necessarily includes shared drainage.	Rural infill may be most common in rural industrial centers where transportation and water infrastructure were constructed to support past/current industrial uses. These areas may be candidates for small industry seeking attractive sites with green amenities.
Retrofits	In urban areas, the most important stormwater improvements, especially coastal cities, may arise from retrofitting properties and infrastructure with LID techniques in areas important for volume control and treatment. However, since NPDES permits only apply to new development and redevelopment, cities may want to use alternative compliance or “in-lieu-of fees” to address retrofit directly. In addition, cities will need to address retrofits through non-NPDES programs. Note that code changes were required to encourage use of solar devices. Local governments may need to add similar language to balance onsite practices in built out areas with property protection from runoff.	Retrofits on the urban edge are likely to focus on residential areas (since they comprise the largest area of developed land). Thus, both NPDES and non-NPDES programs will be needed. Like other retrofit programs, “punching holes” in existing impervious areas can direct improvements. There is also more opportunity for riparian buffers in areas that are less than built out.	The issue of retrofits for rural areas is small, though there may be increased opportunities for transfer of development rights for water harvesting or watershed water balance (for example where increased densification is balanced by an “offset”). However, in agricultural areas, the combined mandates for low impact development and water conservation will drive demand for different stock for commercial landscaping in urban and edge areas.

5.2 LID ELEMENTS OF CODES AND ORDINANCES

As described in Section 5.1, municipalities can employ a variety of approaches for integrating LID into codes and ordinances. A review of codes and ordinances that encourage or require LID from progressive stormwater programs around the country (summarized in Appendix C) shows that there are a number of common elements to the codes and ordinances. Based on these findings, the following are initial steps that communities can take to incorporate LID into their local codes and ordinances:

- Adopt goals and objectives for stormwater management.
- Conduct technical analyses to evaluate and determine appropriate performance standards that help you meet goals and objectives.
- Finalize performance standards.
- Conduct a review of existing ordinances and manuals to identify (1) the need for additional ordinances and (2) needed revisions to existing ordinances to create requirements or incentives for LID and remove barriers to LID. This includes review of existing stormwater, sedimentation and erosion control, subdivision, zoning, and/or unified development ordinances. (A checklist is presented in Appendix D that outlines key features of ordinances and common elements where LID can be incorporated or where barriers may exist.)
- Conduct roundtable discussion of needed ordinance revisions. This discussion should include sectors of the development community, bankers, DOT officials, environmentalists, and local government departments, etc.
- Based on recommendations from the roundtable discussions, draft new ordinance (e.g., stormwater management ordinance) and proposed text revisions for existing ordinances.
- Hold public meetings and public hearings.
- Adopt ordinances.

5.3 OVERCOMING PROCESS BARRIERS TO CODE REFORM

In addressing aspects of codes and development regulations that may pose a barrier to LID, it is important to recognize that the code parameters were put in place to address a particular policy or development matter. Established codes and standards can be difficult to change for a variety of reasons:

- *Fair application of development rules.* One broad standard may be viewed as serving any project that meets size or use standards.
- *Ease of administration*. One enforced standard is easier to implement than several codes.
- *Investment in the status quo*. Stakeholders adjust operations to existing zoning and anticipate financial loss or risk in any change.
- *Legal support*. By using a recognized national code, cities and counties may feel "covered" when safety or other concerns are brought forward with development projects.
- *Margin of safety*. The over-design of infrastructure and development is often attributed to risk reduction for extreme weather or emergency response events.
- *Resource constraints*. Amending standards or offering a choice of codes and standards requires human and financial resources. During project or site review, there are resource implications for training staff or altering engineering models.

- *Lack of outreach and education*. Even as models for better development emerge, there can be a lag time in obtaining buy-in from developers, the public and local Departments.
- *The desire for uniformity and predictability among development projects*. The desire for uniformity is evident in both the public and private sectors. Developers and their financial backers often associate a uniform development style with reduced risk. For cities and the larger public, a move away from conventional development can also be viewed as a risk to the tax base and property values.

5.4 PROGRAM-BUILDING STEPS

Before the effective date of ordinance revisions, a new local program needs to be established to implement the LID provisions. In fact, depending on the degree of local support, work should begin on building program elements during the period of public discussion if the effective date of the ordinance revisions is to be soon after their adoption. Otherwise, the effective date of the ordinance revisions should be delayed by 6 months to one year to allow for capacity building.

The local government is encouraged to have implemented the following steps prior to the effective date of the ordinance revisions:

1. Develop stormwater design manual or revise existing manual to incorporate LID techniques.
2. Develop tools or standardized methods for evaluating compliance with the Performance Standards. These are to be used by project applicants and staff.
3. Develop Standard Operating Procedures for
   - Development review
   - Inspections (including inspections check list; inspections/maintenance documentation procedures; database to manage inspection/maintenance history)
   - Enforcement
4. Conduct analysis of new staffing requirements. Hire staff as needed.
5. Train new and/or existing staff on use of the Design Manual; evaluation methods; standard operating procedures.
6. Conduct workshops for the development community on new requirements. This should ease the transition and minimize mistakes in early submittals.
7. Develop program evaluation framework, including benchmarks to ensure that goals are being met.
8. Be patient and creative. Work with the applicant to find solutions. Remember there is a transition phase when staff and project applicants are learning and helping work out the “kinks” in the manual, evaluation methods, and Standard Operating Procedures. Treating the program as a partnership will increase the likelihood of long-term support and success.

Appendix A: Options for Enhancing LID in California Policies

The following is a list of policies and programs in California through which LID can be promoted or enhanced. The list includes a description of the policy or program, including how it is related to LID, and action items that might be considered to remove barriers to LID implementation and better integrate LID into planning and development policies and practices. This list is intended to be fairly comprehensive, and as a result some of the options may be determined to be infeasible in California for a variety of reasons. This list is not static, as new policies and programs arise regularly. Discussions with other LID stakeholders will likely generate additional policies/programs and action items that should be added to this list.

CONTENTS

A. STATE ENVIRONMENTAL POLICIES

Like many states, California has delegated oversight of infrastructure and the built environment to many entities. As such, many policies can work at cross-purposes and funding priorities may be misaligned. To ensure adequate coordination and mutual support for LID and other environmental goals, State policies should be reviewed and aligned.

Issues

A1. ***Blanket application of a "Meadow" Performance Standard for LID may result in degradation***
Many LID equations set a baseline, pre-development condition against which stormwater management performance can be gauged. A common requirement is that the hydrology of a development site mimics that of a meadow. The "meadow" equation has the effect of treating conversion of a meadow and conversion of an abandoned parking lot as equal in terms of runoff. While this might be desirable in some situations, there could be degradation in other cases, for example if the pre-development condition is a forest, which has greater stormwater attenuation than a meadow. This approach to LID performance also fails to recognize receiving water condition. It may be necessary to institute a two-tiered approach where the first line of questions examines loss of ecosystem services. Thus, conversion of a meadow or forest would require a higher level of treatment and control than conversion of an impacted site.

A2. ***Many State agencies have recently updated codes and standards to include "green practices," though LID is not well represented***
Many improved guidance documents, manuals and directives were recently released (in 2006 and 2007), representing enormous efforts to integrate environmental planning, site design, and operations. Erosion controls for the construction phase of development seem to be the top stormwater priority, as exemplified in the new scorecard for High Performing Schools and the General Services manual.

A3. ***General Plans do not explicitly address LID***
General Plans guide land use and future development and can affect the amount and placement of impervious surfaces in watersheds. General Plans that do not integrate stormwater concerns with other pressing environmental issues such as water supply, total maximum daily loads (TMDLs), water conservation and

infrastructure might allow or encourage development patterns that adversely impact waterbodies. Explicitly incorporating LID goals into General Plans will help to ensure that watershed impacts will be considered on a regional planning scale.

A4. ***Communities require education on LID approaches***
Many local governments have not been educated on the benefits of LID and how to incorporate LID approaches into stormwater management plans, codes, or ordinances.

A5. ***LID not integrated into State Environmental Goals and Policy Report***
Every four years the Governor is required by State law to update the State Environmental Goals and Policy Report. The report was last updated in 2004. The top three priorities in the Report are summarized as follows: (1) to promote infill development and equity, (2) to protect environmental and agricultural resources, (3) to encourage efficient development patterns. Using LID approaches, these three priorities can be addressed to meet State environmental goals.

A6. ***LID projects using CWA §319 funds require a 40 percent non-federal match***
This federal program is among the most popular sources of money for model or pilot projects to mitigate runoff. However, the program requires a 40 percent non-federal match. Over $5 million has been available for projects, which must be implementation projects of between $250,000 and $1 million.

A7. ***Proposition 218 limits stormwater utility formation***
Stormwater utilities are widespread and growing as a way to manage stormwater and drainage. In California, stormwater utility formation is limited due to Proposition 218. Legislation has been introduced to place stormwater funding outside of Proposition 218. In many areas of the country, utilities (actually credits from utility fees) have been an effective means for fostering LID based on monetary incentives (especially for larger businesses and lots).

A8. ***LID is not incorporated into Clean Water Revolving Loan Funds***
The State Water Resources Control Board (SWRCB) sets priorities for the use of funds under the Clean Water State Revolving Loan Fund through annual "Intended Use Plans," in general directing money to the most pressing health and environmental problems first.

Opportunities and Action Items

Legislative

A9. Establish through legislation a statewide requirement that new State-owned buildings and those undergoing renovation to buildings/grounds meet the standard that post-development stormwater peak flow rate and volume from the site match the pre-development stormwater peak flow rate and volume. Note that this is a stringent requirement that may be controversial because this standard may not be feasible where soils are contaminated, in ultra-urban areas, or where the groundwater table is high. An alternative compliance option should be offered to allow developers to provide equivalent watershed benefits where site limitations prevent achievement of the performance standard onsite.

A10. For General Plans, require a new "Water Element" to combine water supply, stormwater, TMDLs, watershed planning, water conservation, LID, water infrastructure, and floodplain management. If legislation to require a Water Element is too aggressive, provide policy support for communities that choose to adopt a water element, including LID. The Local Government Commission's handbook on the Ahwahnee Water Principles (http://www.lgc.org/ahwahnee/principles.html) includes model policy language and information on the initial content for a Water Element.

Aspirational

A11. Develop a prototype two-tiered approach to stormwater that tiers post-construction best management practice (BMP) requirements based on the loss of ecosystem services.

A12. Sponsor a review of California State programs based on barriers or support for joint LID/planning, policy, funding and regulation. Provide suggestions to overcome barriers and highlight best practices. The review may cross-reference the top priorities and include LID.

A13. Sponsor or co-sponsor a regional Low Impact Development Conference to aid in education and training. OPC, in coordination with the State and Regional Water Boards, could develop workshops and training seminars to educate planning authorities and communities on how to incorporate LID approaches into growth strategies; how to design, implement, and evaluate LID approaches; and how to ensure long-term maintenance of LID practices.

A14. Sponsor a mock or pilot CEQA analysis of build-out for a region comparing an LID scenario with current zoning to provide a "ready alternatives analysis" based on LID.

A15. Contact the State's Office of Planning and Research to begin work on integrating low impact designs and development into the State Environmental Goals and Policy Report. This would strengthen the priority to "protect environmental and agricultural resources," which is now geared towards preserving farmland and open space, and should be a complement to the priorities of promoting infill and encouraging efficient land use.

Funding

A16. Support efforts to exempt stormwater funding from Proposition 218 limitations.

A17. Provide part of the 40 percent match for section 319 funding for LID pilot projects, LID planning or other activities covered under Clean Water Act §319.

A18. Work with the SWRCB to assess where changes to the "Intended Use Plans" for the Clean Water State Revolving Loan Fund might be combined with LID to improve water quality. The SWRCB notes in their 2007 Annual Report, Section II, that only 6 percent of funds were delivered to nonpoint source programs, though they will pursue increasing this amount because nonpoint source projects are critical to water quality. In addition, the SWRCB may be open to a "fix it first" alignment of funds for certain water funding programs.

A19. Assist municipalities in seeking grants from the Proposition 84 Storm Water Grant Program that provide matching grants to local public agencies for the reduction and prevention of storm water contamination of rivers, lakes, and streams.

A20. Work with the SWRCB to see where LID can be inserted into Supplemental Environmental Projects, which are financial contributions made as part of an enforcement action under the Clean Water Act. These projects must address the harm reported in the violation. Thus, an enforcement action for lack of sediment control at a construction site might include a LID retrofit for a public park experiencing erosion problems.

B. BUILDING AND ZONING STANDARDS

Building codes and standards are used to prescribe an expected level of health, safety and structural safeguards. These codes are commonly adopted by reference or integrated into local zoning codes. While these codes are vital for numerous reasons, inflexible "one-size-fits-all" codes tend to dictate a development format that cumulatively does not meet new or emerging challenges, in particular environmental challenges. For example, within building codes, traditional drainage parameters are written to move water away from building foundations and into streets through as direct a route as possible. Cities in California are in the process of revising their building codes to adopt new standards based on updates to the California Building Code, as well as other codes such as plumbing, electrical and fire.

Issues

B1. ***Provisions of the California Building Code preclude LID implementation***
The California Building Code includes many site, building and foundation codes, some of which may limit the use of infiltration BMPs. For example, limitations associated with expansive soils, seismic requirements and foundation integrity could all limit onsite infiltration, in particular on small sites where area for infiltration is limited. The new codes include language that allows localities to designate alternative drainage requirements, though this language is vague and does not specifically promote LID.

B2. ***Building footprint limits can drive imperviousness on a larger scale***
Maximum building footprint limitations place an upper bound on the building footprint size (e.g., a footprint can be no more than 30 percent of site coverage). While this is often a strategy for LID because it ostensibly reduces the impervious area attributed to a building, lower caps can drive inefficient land development at a larger scale by spreading out building imperviousness. In addition, parking often ends up occupying the space not used for the building.

B3. ***Building height limits and minimum frontage requirements can spread development outward***
Where development demand is high, building height restrictions tend to spread development outward. Where setbacks are small, this can lead to "horizontal density," which leaves little room to manage stormwater and forces an overall larger degree of low-density, highly impervious development. Minimum frontages (e.g., 100 feet) mandate a large parcel footprint for even smaller establishments.

B4. ***Rigid setbacks can limit LID application***
A setback is the minimum distance a building's side may be constructed from the front right-of-way and adjoining properties. Small setbacks have advantages (they support compact formats) and disadvantages (they leave little room for landscaping and aesthetics). Large setbacks of 30 feet or more add to driveway, walkway and other impervious infrastructure lengths. On the other hand, the larger the setback, the greater the opportunity for infiltration. Setbacks also tend to be rigid, preventing site designers from optimizing infiltration depending on individual site characteristics.

B5. ***New guidance for State buildings includes little direction on post-construction stormwater control***
The California Department of General Services updated its Best Practice Manual for State Buildings (http://www.documents.dgs.ca.gov/green/BPM-bbmbt.pdf) in 2006. The new manual includes information on managing construction site runoff but offers little information on managing post-construction stormwater onsite and provides no information on performance standards.

Opportunities and Action Items

Legislative

B6. Require all State buildings (new and substantial remodeling) to institute LID requirements for buildings, grounds and parking. Work with stakeholders to determine the development and redevelopment thresholds for LID requirements and retrofits.

Aspirational

B7. Sponsor an examination of the California Building Code to see which provisions might impede infiltration and LID, or which provisions require clarification on the use of LID. Use the review to suggest changes to the Building Code to meet multiple goals and provide assistance to local governments that have adopted the California Building Code by reference or are in the process of adopting the updated codes.

B8. Support a program for municipal building and zoning code audits to support environmental improvement (i.e., the audits would address not only stormwater via LID, but watershed, transportation, and heat island issues through more efficient forms of development and redevelopment).

Funding

B9. Provide incentives (i.e., funding for LID and stormwater-related implementation projects) and guidance to communities who agree to audit and modify local codes and standards to allow or promote LID.

C. STREETS, ROADS, AND HIGHWAYS

The design of highways, streets and roads has a high degree of impact on watersheds. The location of new roads, the geometric standards that govern road construction, the width of rights-of-way, and the connections among sites to the larger stormwater conveyance system are all factors that affect the degree of stormwater impacts from development. In addition, roads, even small roads with minimal shoulders, fracture important drainage networks and alter local hydrology.

One emerging issue is construction and improvement of roads in rural areas at the urban-wildland interface. On the one hand, improved roads assist in firefighting response, which is a pressing issue in developed areas adjacent to forests and scrubland. However, improved roads in rural areas can send signals that the areas are prepared to handle more development, which can contribute to sprawl and increased regional imperviousness.

Issues

C1. ***Overly wide street widths***

Street width in California is written into the State Streets and Highway Code, Section 1805 (http://www.legaltips.org/california/california_streets_and_highways_code/). The code requires that the width of all city and county streets and county highways (other than bridges, alleys, lanes and trails) shall be at least 40 feet wide. A county board of supervisors may elect smaller streets only by a unanimous vote of its members; within cities the requirement is a 4/5 vote. Also, emergency responders tend to request overly large street widths for maneuvering large equipment and vehicles. Engineering guides used throughout California establish minimum street and right-of-way widths, which can also include bike lanes, sidewalks, medians and planters. Efforts to reengineer streets, including reduced widths, are underway, mainly through Specific Area Plans.

C2. ***Overly wide sidewalks and sidewalks on both sides of the street***

While walkability is a popular amenity and even integral to transportation, wide sidewalk requirements on both sides of the street add impervious cover. In addition, the Americans with Disabilities Act requirements direct sidewalk placement and widths, which are needed for accessibility.

C3. ***Inefficient street layouts***

Most states, including California, have built highway systems based on a hierarchical model. This model funnels traffic from residential projects to local streets, to arterials and then to freeways. The system tends to arise where development is unconnected and scattered throughout a watershed. This adds to imperviousness and congestion, reduces options for alternative routes, and limits non-auto modes of travel.

Title 14 of California's Public Resource Code includes minimum road standards for wildland areas. Many county manuals mandate certain concrete, asphalt and substrate materials, in part to bear the weight of larger vehicles (often up to 40,000 pounds). Many cities and counties adopt standards developed by Fire Protection Districts (for example Ventura County's access standards, http://fire.countyofventura.org/departmentservices/fireprevention/standards/index.asp). These rules require certain paving materials and can prohibit the use of pervious pavers and alternative materials for access ways, parking lots, shoulders and turnarounds. Even where codes only apply to certain fire-prone areas, the standards are sometimes adopted for the entire county or city.

C4. ***Funding for streets and highways from the California State Controller does not encourage LID***

In 2004, the California State Controller's Office issued Guidelines Relating to Gas Tax Expenditures For Cities and Counties (http://www.sco.ca.gov/aud/gastax/gastax2004.pdf) to describe how funds collected for vehicles and gas, the major source of transportation infrastructure funding for localities, may be used. This authoritative document was developed to assist cities in determining how gas taxes may be used for street and highway improvement. While LID techniques appear to be included in the narrative, the definitive list of techniques that may be used, even for environmental mitigation and retrofits, is dominated by engineering approaches.

Opportunities and Action Items

Legislative

C5. Require that LID be incorporated into any new Caltrans road project, where feasible. Work with Caltrans planners to identify appropriate BMPs and performance standards for different types of road projects.

C6. Require LID retrofitting with any State-sponsored repair or maintenance project. This may include new materials for shoulders, the use of paving alternatives or improvements to stormwater management. Work with stakeholders and Caltrans to determine repair/maintenance project thresholds for the use of LID retrofits.

C7. Remove the 40-foot minimum street width from the Street and Highway Code for city and county streets.

Aspirational

C8. Work with Caltrans planners on the following programs that can include an LID or "green streets" component:

- Add an LID component or develop an LID matrix for "Corridor System Management Planning" projects intended to retrofit major corridors (http://www.dot.ca.gov/dist3/departments/planning/corridorplanning.html)
- Incorporate LID goals and objectives into the "Regional Blueprint Project" and the "Blueprint Learning Network" (http://www.dot.ca.gov/hq/tpp/offices/orip/bln.html).

C9. The Congress for the New Urbanism recently was awarded a grant to work with emergency responders nationwide on the issues of street widths, design and access. The State could support work on the paving materials and street design aspects of the project, since these should be part of the larger discussion. The State may also want to explore discussions on vehicle and apparatus design, since road designs are driven by the need to support vehicle size and weight. In California, the Local Government Commission has developed State-specific materials and training.

C10. Develop a High Performing Infrastructure report that integrates all utilities and infrastructure located in public rights-of way, including natural drainage (similar to that developed by New York City, http://www.designtrust.org/publications/publication_03hpig.html).

C11. Contact the California State Controller's Office to update and clarify language related to use of gas tax funding for environmental improvements and LID. Note that the Controller's Office has also issued Guidelines on use of Traffic Congestion Relief Funds (http://www.sco.ca.gov/aud/traffic/ab2928.pdf), which states that:

> Funds may also be used for the cost of work that is associated with and incidental to a street or road maintenance or reconstruction project within the street or road right-of-way, provided the work is necessary and/or required to bring the street or road to current design standards.

Further language refers to "associated curb and gutter work," though the overall wording tends to imply engineering approaches. The State can approach the Controller to see if specific guidance on "green streets" can be developed.

Funding

C12. Caltrans is developing a "smart mobility" scorecard to institute a new prioritization system for allocating funds. This scorecard will be used to underwrite investments in street systems that better support existing developments and pedestrian and bike infrastructure and improvements. This same type of scorecard might be used in distribution of stormwater infrastructure and nonpoint source funding.

D. PARKING LOTS

The impact of parking cover tends to fall into two categories: (1) decisions on overall parking supply and (2) the design of individual spaces and lots. In general parking is oversupplied due to the use of high minimum standards, requirements from financial lenders, and the lack of incentives to share parking among individual land uses. In general, workable reductions in the footprint of parking require a multi-disciplinary, planning approach.

Issues

D1. ***Parking lot landscaping requirements preclude infiltration***
Many parking lot codes require a continuous elevated curb around landscaped areas, which eliminates the ability to direct runoff into natural areas.

D2. ***Parking lot surface requirements limit porous pavement application***
Some parking codes limit the material selection to asphalt and concrete, prohibiting the use of permeable pavements.

D3. ***Overly large parking space dimensions***
Many codes require minimum space dimensions, as well as dimensions for drive aisles. In some cases, residential codes require a minimum number of spaces for recreational vehicles in addition to automobiles. Overly generous stall dimensions can increase parking lot imperviousness by 15 percent.

D4. ***Minimum required number of parking stalls leads to too many spaces***
Parking allotments often overstate actual demand and a minimum standard allows for more parking at the developer's discretion. The Institute for Transportation Engineers' "Parking Generation" establishes minimum number of parking stalls rather than maximum. Financial institutions tend to require extra parking as a margin of safety for overflow, even though extra spaces tend to be factored into the minimums. All of these factors contribute to increased parking lot impervious surface.

D5. ***Shared/joint parking and loading prohibited or not incentivized***
Many local codes either prohibit joint/shared parking, or give little incentive to do so. As such, the system errs on the side of oversupply for each project that is built or redeveloped, resulting in additional impervious surface.

D6. ***Zoning code limitations on charging for parking***
Many California cities prohibit charging for parking for any spaces that are required by code. This eliminates a market-based tool for to manage parking demand.

D7. ***Parking costs are "bundled" into rents***
Parking costs are "bundled" into rents, which (1) charges parking costs to renters who do not own cars and (2) conceals the true cost of parking. One strategy being used across the country is the unbundling of parking and rent costs, which provides more transparency on the costs of parking and can reduce parking demand. Lower demand means smaller lots.

Opportunities and Action Items

Legislative

D8. For parking lots serving State buildings, require that any maintenance or resurfacing project affecting more than 20 percent of the lot include LID retrofits that address runoff for the entire lot (or some negotiated percentage of the lot based on site constraints).

D9. Require that all sections within municipal zoning codes related to parking present both a minimum and maximum parking space allotment. Alternatively, require all State buildings to adhere to both minimum and maximum parking numbers.

D10. Draft enabling legislation allowing cities and counties to treat any surface parking over and above the minimum prescribed amount differently in stormwater management calculations. For example, developments

with excess parking space would be required to manage 150 percent of the stormwater volume or provide an equivalent degree of off-site management/retrofit.

D11. Prohibit the practice of limiting parking charges for any parking required under code.

D12. Craft legislation requiring the unbundling of parking costs for residential sites that are within one mile of heavy rail or fixed guideway transit stations, one half mile of bus transfer stations and one quarter mile of bus stops. Proximity to public transit offers residents alternatives to driving/parking, allowing them to choose not to pay for parking once costs become transparent.

Aspirational

D13. Provide a model parking sharing arrangement to foster joint and shared parking.

Funding

D14. Provide funding for communities to conduct parking demand studies.

D15. Fund pilot projects testing innovative parking lot designs and the use of innovative materials.

E. LANDSCAPING

The landscaped areas of development and redevelopment sites offer opportunities for stormwater management, even on small parcels in ultra-urban areas. However, cities often develop guidance documents and zoning code language that result in undesired environmental practices (e.g., the use of fertilizer- and water-dependent plants, limitations on efficiently using open space for infiltration, and engineering requirements that inhibit runoff capture and treatment).

Issues

E1. ***Landscaping codes and ordinances can conflict with LID***
Most California localities include landscaping ordinances within their zoning codes. LID in urban areas generally applies to commercial landscaping, including multi-family residential projects and landscaping within parking lots. Some landscaping codes reduce areas for stormwater infiltration by not specifying appropriate infiltrative soils. Others encourage raised landscaping by requiring planting areas be protected by curb or wheel stops, which eliminates the ability to treat runoff in landscaped beds. In addition, some codes limit the use of non-plant materials, such as gravel, to 10 percent of the area. This limits the ability to use rocks and gravel for energy dissipation, which is essential for hydromodification control. The lack of understanding how LID approaches can be incorporated into landscaped areas often result in a greater amount of land area dedicated for traditional stormwater controls and conveyance.

E2. ***Water conservation is not explicitly linked to LID and stormwater management***
In 2006 new legislation took effect under the Water Conservation in Landscaping Code (http://www.cuwcc.org/ab2717_landscape_task_force.lasso). Language on stormwater infiltration and reuse is in the legislation, though it is not strong. As new stormwater permits are issued, a bond will need to be forged among LID, permit performance standards, and the landscaping rules. Note that much of the language on water conservation in landscaping pivots on water budgets and irrigation. The use of LID will affect these budgets, though little research has been done to determine how stormwater infiltration will ultimately be factored into these budgets.

E3. ***Many exemplary landscaping codes include requirements for maintenance***
Maintenance of stormwater BMPs, including LID techniques, is often overlooked, resulting in reduced performance in handling volume and removing pollutants. Audits of the Phase I program by EPA showed that lack of maintenance was the top weakness of the stormwater program. As such, zoning codes that include maintenance (including inspection and enforcement) can be modified and used to sustain the benefits of LID.

Opportunities and Action Items

Legislative

E4. Require greater minimum area dedicated to landscaping in development and redevelopment codes. Require that a Landscape Plan include a site evaluation of existing conditions (soil hydrology, vegetation) to consider in designs before grading or other impacts to the site have taken place. Provide model ordinance for these changes.

Aspirational

E5. Contact the California Urban Water Conservation Council (http://www.cuwcc.org/home.html) on integrating LID into new guidance and model codes. The language on infiltration exists and provides an "in" for LID, but it is not strong. The potential exists for codes to be written without factoring in water budget changes that arise from capturing water onsite. Some work is underway: the Urban Water Conservation Council must develop a model code by January 1, 2009, with local ordinance adoption within one year.

E6. Develop a cross-program education and communications strategy for LID, including options for urban areas, master planned areas, new development, redevelopment and infill.

E7. Provide technical assistance (e.g., guidance, trainings) for incorporating LID into local codes and for design, installation, and long-term maintenance of landscape-based BMPs, including pesticide, fertilizer, and herbicide use.

E8. Work with the California Nursery Growers Association on ramping up plant selection and practices to meet both LID and upcoming water conservation standards. http://www.nurserygrowers.org/index.html.

F. OPEN SPACE

California has many programs devoted to preservation of open space, forests, park land, and desert land. Last year, legislation limiting development in floodplains increased protection of streamside open space. Urban open space, parkland and forestry are important but often overlooked opportunities to manage runoff. To make the most efficient use of open space for stormwater management, areas that have natural drainage properties amenable to LID should be dedicated for this use. Minimum open space requirements that do not take into consideration these site properties may not provide adequate stormwater management benefits.

Issues

F1. ***Minimum open space requirements might drive inefficient land use***
California requires minimum open space for multi-family residential projects. While open space is an important component for urban areas, large minimums may be driving inefficient land use without providing meaningful natural or recreational spaces. The open space requirements for multi-family residential projects are often in addition to other requirements such as parking, setbacks, internal circulation, sidewalks, club houses and other amenities. In addition, many local codes disallow land devoted to onsite stormwater management to count towards the minimum open space provisions. However, reducing open space is likely to be controversial because most assessments of the value of open space do not consider any countervailing effects on efficient use of land.

F2. ***Inconsistent and inadequate buffer widths***
Aquatic buffers serve as natural boundaries between local waterways and existing development. They help protect water quality by filtering pollutants, sediment, and nutrients from runoff. Other benefits of buffers include flood control, stream bank stabilization, stream temperature control, and room for lateral movement of the stream channel. Good aquatic buffer ordinances specify the size and management of the stream buffer and are a specific planning tool to protect stream quality and aquatic habitat. Buffers can be multifunctional, serving as areas for sheet flow and infiltration to reduce stormwater pollutants and volume, improve baseflow conditions and increase groundwater recharge.

F3. ***The Williamson Act can be used to prioritize preservation of infiltration areas***
The California Land Conservation Act of 1965 (Williamson Act) enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. Landowners receive property tax assessments based upon farming and open space uses as opposed to developed market value. Local governments receive an annual subvention of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

Opportunities and Action Items

Legislative

F4. Create a Williamson Act/Open Space Subvention Act of 1971 counterpart for infiltration and aquifer recharge. Base the program on areas best suited for infiltration. Alternatively, allow localities to include infiltration as "production" under the Williamson Act in areas delineated for aquifer protection.

F5. Require that open space designations be reviewed during local plan review to assure that the area is used in the most efficient manner for present and future needs, including stormwater management and groundwater recharge. The State can provide model ordinance language to require open space designation review.

Aspirational

F6. Provide examples of supplying land-efficient open space from other parts of the country, in particular for dense urban districts. Alternatively, develop and promote examples of open space landscaping that supports both stormwater handling and active/passive recreation (e.g., using soccer fields as infiltration basins, developing water gardens with aesthetic and stormwater treatment functions).

F7. Encourage local governments to adopt ordinances that apply minimum buffer widths and maintenance requirements to all lots that are contiguous with or directly adjoin an intermittent or perennial stream or river, particularly those identified in and consistent with impairments or threatened/sensitive species.

G. SCHOOLS

School building and renovation offer LID opportunities. The decision of whether to redevelop an existing school or build anew at another location has broad watershed implications. First, older schools tend to be located on smaller sites. Secondly, the increasing costs of land and construction exert financial pressure to build on cheaper, more distant, and undeveloped land. A variety of factors then feed into the ultimate footprint of the school, including parking, pick-up, fields, classroom size and the like. California has been a national leader in school siting reform, including a push to use schools as centers of community and voter approval of funding to provide green retrofits.

Schools provide an ideal opportunity to demonstrate LID approaches to the public because they serve as polling places and meeting locations in addition to educational facilities. Operation and maintenance can generally be assured at schools. Placement of stormwater management features on school grounds can provide opportunities for LID outreach and education to children and adults. There are still areas of improvement needed, in particular as it relates to the overall stormwater and carbon footprints of new schools.

Issues

G1. ***"Schools as Centers of Community" policies can be used to promote LID***
California has instituted "Schools as Centers of Community" policies over the past decade to efficiently supply services, parks and facilities. School parking lots, fields, land and landscaping may provide capacity to address local flooding, provide land or storage for stormwater and otherwise address stormwater hotspots.

G2. ***School Facility Hardship Grant Program might discourage LID and/or redevelopment***
California's School Facility Hardship Grant Program, which provides grants to correct safety problems, discourages school districts from considering renovation options for historic schools by limiting funding if renovation costs exceed 50 percent of the cost of new construction. This can limit renovation of already

developed properties, which might include incorporation of LID into landscaped areas. This policy may encourage school construction on undeveloped lands, which increases impervious area (newer schools typically have a larger footprint), requires additional infrastructure and can increase brownfield or vacant land(if the old school property is not redeveloped.

Opportunities and Action Items

Legislative

G3. Require LID for new school construction. Where feasible, require use of school property for collective drainage and infiltration. For new and existing schools, require water harvesting equal to a locally preferred design storm (for example the design storm used for transportation projects). Where possible encourage school construction or reconstruction on infill or redeveloped lands and discourage construction on undeveloped lands. The State can provide incentives (i.e., funding for LID and stormwater-related implementation projects) and guidance to communities who agree to modify local codes and standards to promote infill and redevelopment.

Note that the California Department of General Services and California High Performing Schools initiative recently launched its $100 million High Performing Schools Program, funded by Proposition 1D in 2002. The criteria for selection and level of funding is based on a scorecard (http://www.chps.net/manual/documents/CHPS-NewConstruction_Scorecard_060821.xls), which only has a non-required stormwater item for "minimizing runoff," although other factors might reduce runoff, such as a factor to "minimize parking."

Aspirational

G4. Under recent legislative changes, school districts may develop Master Environmental Impact Reports (EIRs). The State can work with the Department of Education's facilities group to integrate LID into all master EIRs for educational facilities.

G5. Encourage passage of State legislation to require new school construction to meet LEED Silver standards.

Funding

G6. Sponsor water infrastructure upgrades to include LID in existing schools. By underwriting new infrastructure for historic schools, energy and water costs can decrease and in some cases they can address deferred maintenance that might otherwise feed into the renovation cost calculation and tip the decision to new construction. One group that has been effective at this is TreePeople in Los Angeles.

H. District Planning, Redevelopment, and Infill

Increasingly, cities and counties are turning to district planning for efficient delivery of services, coordinated infrastructure, and economic development. Although most LID codes and examples have been applied to individual sites, one key to effective implementation is how the larger area performs for watershed health and restoration. This involves how streets are designed; what the use mix is; how accessible common trips are to jobs, home and school; the extent to which site elements are shared; the footprint of development; and how open space is used (or set aside).

In California, there has been an upsurge in district planning. New models of district planning have been launched and fine-tuned in California, including form-based codes, new urbanism, transit-oriented development, and a new Leadership in Energy and Environmental Design (LEED) pilot for neighborhood development (LEED-ND). For redevelopment, main streets, infill and highway corridors have been the focus of activity. For new development, traditional neighborhood design, master-planned communities, conservation or cluster subdivisions, mixed-use projects (sometimes called "lifestyle centers"), and planned unit development projects, are common formats.

The regulatory structure for district planning typically rests on specific area planning. These plans often occupy a separate section within zoning codes and have detailed maps and infrastructure plans. Financing for districts is complex. For redevelopment, redevelopment agencies usually oversee special financing through tax-increment

financing. Impact fees can pay for new development, though "community financing districts," or Mello-Roos districts (see http://www.mello-roos.com/pdf/mrpdf.pdf), are increasingly used to pay for construction, operation and maintenance. Note that Mello-Roos districts can also be formed for redevelopment districts, though the more common application is for new development.

Issues

H1. ***LID requirements are often written to apply to individual projects, which results in uneven application***
LID is often defined as a site-level approach, and as such, many LID regulations set one uniform performance standard across all "projects" that are part of a "common development plan." Developers of large greenfields projects have leeway in arranging lots and open space to meet the performance standard. For example, if a new development must be limited to no more than 10 percent impervious cover, individual home sites need not meet this requirement as long as the overall development plan has less than 10 percent cover. However, for redevelopment, most projects are individual sites with little or no space or flexibility for BMP design. This creates a situation where a large greenfield project allows flexibility as a common development plan, but redevelopment must meet the entire performance standard within the site boundaries.

H2. ***Research on district-level LID is limited***
Most research on LID efficacy has been conducted on individual sites. The most robust data for a subdivision, from the Jordan Cove National Nonpoint Source Monitoring Program project in Connecticut (http://www.jordancove.uconn.edu/), was only recently released.

H3. ***LID often designates hydrology as the indicator of environmental impacts***
By their regulatory nature, stormwater rules have the farthest reach into zoning codes. These rules tend to emphasize stormwater peak flow attenuation and volume capture, causing hydrologic performance to outweigh other important environmental issues that are considered in non-regulatory planning documents, such as infill and redevelopment priorities and regional growth patterns that can affect watershed health.

H4. ***Suburban-style LID requirements can run counter to the planning, transportation and climate emphasis on compact design***
Meeting strict stormwater performance standards in urban areas can be much more difficult than in open areas with room for swales, infiltration and detention. While LID techniques can decrease costs for greenfields applications, they can pose higher costs for urban developers, since underground vaults are often needed to augment urban green building, streetscape and landscape BMPs to meet performance standards.

H5. ***Barriers to redevelopment***
Many barriers stand in the way of redevelopment projects compared to new development in greenfield areas. Developers who undertake redevelopment face different (and almost always more) barriers to redevelop a parcel than those who build new projects in greenfields. Barriers include small, odd-shaped lots, multiple ownership, localized economic blight, outdated infrastructure, increased number of required permits and opposition from existing residents and businesses.

H6. ***Redevelopment sites may not offer the same level of receiving water and flood mitigation benefits***
Redevelopment sites differ based on a number of factors that affect LID applicability and efficacy, such as the condition of infrastructure, pollutants of concern, economic development prospects, restoration potential and degree of impervious cover. Most LID requirements apply a blanket threshold and performance level based one or more gross categories (e.g., "new development" or "significant redevelopment"). This blanket approach does not account for constraints at individual redevelopment sites that might limit LID implementation. Strict performance rules might preclude redevelopment of an infill property, despite significant community benefits and the regional benefit of concentrating imperviousness in the urban center and reducing sprawl. Also, some receiving waters in heavily urbanized areas are so impaired that only through redevelopment will there be opportunities to install onsite practices and provide restoration opportunities.

H7. ***There is growing belief that subwatershed planning is the best structure for matching BMPs to runoff stressors***
The easiest method for developing regulations is through uniform performance standards that apply equally to all sites within a jurisdiction. However, this may not adequately match BMPs to the development context, economic factors, and specific stormwater problems, especially related to redevelopment and retrofits.

Moreover, the Basin Plans developed by Regional Water Quality Control Boards often do not align with land development plans, Integrated Regional Watershed Management Plans, and NPDES stormwater requirements.

H8. ***General Permits discourage infill***
Construction Activities Stormwater General Permit (or local grading permits) are often inflexible in their stormwater management requirements and as a result discourage infill and redevelopment that could incorporate LID. Many stormwater codes do not encourage infiltration practices because of the perceived potential contamination issues. Also, some developers perceive that LID practices require a much greater area and that they dramatically reduce the buildable area. These misperceptions, along with a lack of recognition that integrated management practices can be shoehorned into required landscaping (i.e., stormwater planters), leads developers to dismiss the LID approach.

Opportunities and Action Items

Legislation

H9. Create legislation directing the SWRCB to more fully develop "Redevelopment Project Area Master Plans" as described in the draft Ventura County Municipal Stormwater Permit.

H10. Introduce legislative language to classify certain affordable housing/infill projects as post-construction BMPs based on their location and configuration in the watershed (according to General Plans and local housing plans). This program might be based on the spreadsheet model such as that developed by Grand Rapids, Michigan, or others, which estimate the impervious cover prevented by directing housing construction to infill areas identified for growth.

H11. Sponsor legislation to require consideration of natural drainage as an initial step within Subdivision Map Act, as well as rules on Master Plans and Specific Area Plans.

Aspirational

H12. Sponsor an analysis of pilot neighborhoods in the LEED-ND program to see if they meet stringent stormwater requirements (for volume, treatment and flow control). Similarly, conduct a survey of LEED-certified buildings to see how they perform relative to stormwater performance standards in permits. Note that this may be somewhat risky if the first generation of buildings fail to meet recent performance standards. For a list of projects in LEED-ND, see http://www.usgbc.org/ShowFile.aspx?DocumentID=2960.

H13. Sponsor a pilot analysis of the stormwater, climate, and other environmental impacts of vacant property (i.e., the runoff volume created and miles traveled past "dead" sites). Develop strategies to encourage redevelopment and improvement of these sites (requiring LID where feasible). Alternatively or in addition, lobby for the establishment of a program, such as a neighborhood improvement initiative, to convert these sites to parks/open spaces that act as "urban sponges" that capture and infiltrate stormwater from adjacent properties.

H14. Sponsor a pilot study to align major water planning documents (e.g., Basin Plan, Integrated Regional Watershed Management Plan) with regional and local requirements (e.g., stormwater permit requirements and local zoning codes) with respect to LID goals and requirements.

H15. Sponsor a study of "community facilities districts" or Mello-Roos, to see how LID would be treated (or constrained) for new development, infill and redevelopment. Investigate the legal structure and issues related to construction, operation and long-term maintenance under such districts. Because the maximum term and maximum bond amount must be specified up front, this research could provide guidance on assessing this cost. Finally, the study should include an analysis of costs for LID versus traditional conveyance systems as they relate to overall costs for the district.

H16. Create a tool similar to "redevelopment ready" districts that pools existing and planned stormwater improvements for multiple redevelopment sites and considers shared drainage and LID for a pre-permitted district. This will help "level the regulatory playing field" between greenfield and infill development sites by allowing more flexibility for placement of stormwater features in the redevelopment district.

Funding

H17. Fund a project to better describe LID techniques based on development settings in California similar to the effort underway within the Congress for New Urbanism based on the "transect." The transect establishes seven transect zones based on intensity of development and urban form. This approach was used to develop new street standards and could serve as a model for stormwater management as well.

H18. Provide funding for localities that are taking a subwatershed approach to matching BMP selection, development context and pollutants of concern.

H19. Provide matching funds for BMPs installed in mixed-use housing projects. Such a program would need to prioritize funding based on multi-objective planning needs, location in a watershed or alignment with redevelopment/housing program needs.

H20. Provide funding to retrofit or supply LID for small-scale, stand-alone businesses or business districts in economically challenged neighborhoods.

Appendix B: LID Policies Outside of California

The following is a brief summary of stormwater- and LID-related policies from other states that have relatively innovative requirements. It also includes a new requirement for federal buildings and a summary of the LEED-ND standards.

CONTENTS

CONNECTICUT

Policy Structure	The Connecticut Clean Water Act (CCWA) of 1967 (P.A. 67-57) launched Connecticut's modern water pollution control program. This statute (Chapter 446k of the Connecticut General Statutes (CGS)) forms the authority for Connecticut's Department of Environmental Protection to regulate discharges to surface waters under both the CCWA and the federal NPDES Program.
Impervious Surface	Stormwater management requirements are triggered for projects one acre or larger or industrial development creating 10,000 square feet or more of impervious cover. Residential projects with fewer than 5 dwelling units are required to manage stormwater only if final impervious cover will exceed 30%. Impervious cover should be measured from the site plan and includes all impermeable surfaces that are directly connected to the stormwater treatment practice such as paved and gravel roads, rooftops, driveways, parking lots, sidewalks, pools, patios and decks.
Infiltration	Developers are required to maintain predevelopment groundwater recharge volume to the MEP through the use of infiltration measures. The groundwater recharge volume (GRV) is the post-development design recharge volume (i.e., on a storm event basis) required to minimize the loss of annual pre-development groundwater recharge. The GRV is determined as a function of annual pre-development recharge for site-specific soils or surficial materials, average annual rainfall volume, and amount of impervious cover on a site.
Innovative Measures	Typical of other states
LID Requirements	No requirements, but the 2004 Connecticut Stormwater Quality Manual contains summary descriptions of small-scale LID practices. The design sections of this Manual contain more detailed guidance for similar, larger-scale stormwater treatment practices such as bioretention, infiltration, and filtration system.
LID Incentives	N/A
Redevelopment	N/A
Links to Language	Statute: http://www.cga.ct.gov/2005/pub/Chap446k.htm Connecticut Stormwater Quality Manual: http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325704

DELAWARE

Policy Structure	The Delaware Sediment and Stormwater Regulations set forth requirements for post-construction stormwater management.
Impervious Surface	N/A
Infiltration	The regulations include guidelines and technical standards for the use of infiltration practices but do not require a particular level of infiltration.
Innovative Measures	The Delaware Sediment and Stormwater Regulations state that the state's overall goal is to utilize stormwater management as a means to minimize water quantity and water quality impacts and to mimic pre-development hydrology to the MEP in regards to the rate, volume, and duration of flow. Projects in certain watersheds (Mill Creek, Little Mill Creek, Red Clay Creek, White Clay Creek, Persimmon Creek, and Shellpot Creek) need to control runoff volume to mimic pre-development land use conditions using recharge, infiltration, and reuse where site conditions allow.
LID Requirements	The state's preferred option for water quality protection is the use of "Green Technology BMPs." Other practices can only be considered after the preferred practices have been eliminated for engineering or hardship reasons as approved by the plan approval agency.
LID Incentives	N/A
Redevelopment	N/A
Links to Language	Delaware Sediment and Stormwater Regulations: http://www.dnrec.state.de.us/dnrec2000/Divisions/Soil/Stormwater/Regs/SSRegs_4-05.pdf Green Technology Guidance: http://www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/New/DURMM_TechnicalManual_01-04.pdf

DISTRICT OF COLUMBIA

Policy Structure	The District of Columbia is working with EPA to revise its NPDES permit to add innovative LID features. These were outlined in a letter to EPA dated November 27, 2009. Permit language had not been finalized at the time of this report's publication.
Impervious Surface	N/A
Infiltration	The regulations include guidelines and technical standards for the use of infiltration practices but do not require a particular level of infiltration.
Innovative Measures	Initiatives include • A tree-planting goal of planting and maintaining 13,500 trees in the manner recommended by the Green Build-Out Model. Current tree planting rate is more than 4,000 trees per year. • Development of a master LID implementation list and construction of 17 LID projects by August 2009. • Conversion of paved or hardened areas throughout the District, such as traffic street medians and large sidewalk areas into green space in the form of pocket parks or green streets. • LID incentives will be extended to include rain barrels and downspout disconnections. • Installation of approximately 50 rain gardens and 125 rain barrels and disconnection of 200 downspouts. Review of District properties for feasibility of green roof retrofits. Commitment to include green roofs on new buildings and major renovations where feasible.

DISTRICT OF COLUMBIA

LID Requirements	N/A
LID Incentives	The District plans to develop legislation to establish tax credits or other incentives programs for installation of green roofs on non-governmental buildings.
Redevelopment	N/A
Links to Language	Letter of agreement sent from the District to EPA outlining new LID measures (and other changes to their NPDES permit requirements): http://www.epa.gov/reg3wapd/npdes/dcms4.htm

MARYLAND

Policy Structure	The state recently adopted the Stormwater Management Act of 2007 that requires that Environmentally Sensitive Design (ESD), which is similar to LID, be implemented to the MEP. The Act also specifies the practices considered to be ESD. Previously, ESD had been encouraged through stormwater credits (see LID incentives). The purpose and scope of the previous (adopted in 1983) stormwater regulations (Code of Maryland Regulations 26.17.02,) states that "the primary goal of the State and local stormwater management programs is to maintain after development, as nearly as possible, the predevelopment runoff characteristics." Under the state stormwater regulations, all counties are required to adopt stormwater ordinances. The stormwater regulations specify minimum requirements for the county stormwater ordinances. The stormwater design manual interprets the stormwater regulations and provides guidelines and credits towards compliance.
Impervious Surface	From 2000 SW Design Manual page 1.13: Performance Standard 1: Site designs shall minimize the generation of stormwater and maximize pervious areas for stormwater treatment.
Infiltration	Recharge volume required as part of BMP design. The goal of this requirement is to maintain existing or predevelopment recharge rates.
Innovative Measures	Typical of other states
LID Requirements	The 2007 Act is likely to result in LID-related requirements.
LID Incentives	From page 5.17 of 2000 Stormwater Design Manual: Developments less than 15% impervious can be exempt from structural practices if they employ environmentally sensitive development techniques, which have LID elements including disconnection of rooftop runoff, use of grass swales, and dedication of natural areas. The manual provides other credits under the broader umbrella of Innovative Site Planning.
Redevelopment	From Code 26.17.02.05: Reduce existing imperviousness by 20%, or provide water quality treatment for 20% of site's imperviousness, or use a combination of imperviousness reduction and water quality treatment equal to 20%, or implement a locally approved practical alternative (e.g., fees, off-site implementation, watershed or stream restoration or retrofitting).
Links to Language	Stormwater Management Act of 2007: http://mlis.state.md.us/2007RS/chapters_noln/Ch_121_sb0784T.pdf

MASSACHUSETTS

Policy Structure	EPA is responsible for issuing stormwater general permits for construction sites disturbing more than one acre under the NPDES General Permit for Stormwater Discharges from Construction Activities. Although EPA is issuing authority, the MADEP reviews the conditions of each permit, certifies the program unconditionally, or with specific conditions according to requirements of Section 401 of the Federal CWA. In addition to the EPA NPDES requirements, the MADEP has state standards for stormwater discharges which are enforced through different MADEP regulations, including, but not limited to, the Mass. Wetlands Protection Act regulations (310 CMR 10.00), Mass. 401 Water Quality Certification regulations (314 CMR 9.00), and Mass. Surface Water Quality Discharge Standards (314 CMR 3.00 and 4.00).
Impervious Surface	N/A
Infiltration	From the Stormwater Management Policy Handbook: "Recharge must be provided to offset the recharge lost due to site development to the maximum extent practicable and determined using the existing (pre-development) soil conditions [according to hydrologic soil group]."
Innovative Measures	Typical of other states
LID Requirements	N/A
LID Incentives	N/A
Redevelopment	From the Stormwater Management Policy Handbook: Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions. Definition -- Redevelopment projects include: Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, and correcting substandard intersections and drainage, and repaving; and Development, rehabilitation, expansion, and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area.
Links to Language	SW Management Handbooks and other documents: http://www.mass.gov/dep/water/laws/policies.htm#storm

NEW JERSEY

Policy Structure	Stormwater management requirements are specified in the New Jersey Administrative Code (NJAC), Title 7, Chapter 8 Stormwater Management. Major developments (defined as disturbing one or more acres of land or increasing impervious surface by one-quarter acre or more) are required to comply with the stormwater management rules. When municipalities, counties, or regional governments develop stormwater management plans, they must use the stormwater rules as minimum standards.
Impervious Surface	*7:8-5.3 Nonstructural stormwater management strategies* requires that standards be met using nonstructural practices to the MEP, including minimizing and disconnecting impervious surface.
Infiltration	The state requires that developers demonstrate through hydrologic and hydraulic analysis that (1) the site and its stormwater management measures maintain 100 percent of the average annual preconstruction groundwater recharge volume for the site, or (2) that the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm is infiltrated. This groundwater recharge requirement does not apply to

NEW JERSEY

	projects within the "urban redevelopment area," or to projects subject to restrictions related to industrial uses and other land uses producing potentially high pollutant concentrations that could impact ground water quality; also see exemptions under 7:8-5.2d.
Innovative Measures	Typical of other states
LID Requirements	*7:8-5.3 Nonstructural stormwater management strategies* requires, to the maximum extent practicable, that performance standards (N.J.A.C. 7:8-5.4 and 5.5) be met by incorporating nonstructural stormwater management strategies into the design that: • Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss. • Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces. • Maximize the protection of natural drainage features and vegetation. • Minimize the decrease in the time of concentration from pre-construction to postconstruction. • Minimize land disturbance including clearing and grading. • Minimize soil compaction. • Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides. • Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas. The State has developed a Nonstructural Strategies Point System to assess whether developers have implemented nonstructural controls to the MEP. Alternative compliance is available with justification. Any land area used as a non structural stormwater management measure to meet the performance standards in N.J.A.C. 7:8-5.4 and 5.5 shall be dedicated to a government agency, subjected to a conservation restriction filed with the County Clerk's office, or subject to Department approved or equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.
LID Incentives	N/A
Redevelopment	Urban redevelopment areas are exempt from recharge requirements. For redevelopment, the water quality provisions of the Stormwater Management rules only apply if the impervious surface onsite increases by at least 0.25 acres.
Links to Language	Stormwater Management Rule Related Information: http://www.state.nj.us/dep/watershedmgt/rules.htm Stormwater Management Rule: N.J.A.C. 7:8 text: http://www.nj.gov/dep/rules/adoptions/2004_0202_watershed.pdf New Jersey Stormwater Best Management Practices Manual: http://www.njstormwater.org/bmp_manual2.htm Nonstructural Strategies Point System Information: http://www.nj.gov/dep/rules/adoptions/2004_0202_watershed.pdf

OHIO

Policy Structure	In Ohio, responsibility for regulating storm water is held by both local and state authorities. Locally, municipalities, townships and counties all have authority to regulate storm water. Ohio EPA, authorized by the regulations at Chapter 6111 of the Ohio Revised Code (ORC), administers the state regulations that require storm water permits for construction sites. These requirements established the basis of the permit requirements contained in the 2003 Ohio Environmental Protection Agency General Permit for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System. Draft permits specific to portions of the Olentangy River watershed and portions of the Big Darby Creek Watershed are in development. In addition to the rules and general permit, Ohio specifies stormwater performance and design criteria and sediment and erosion control standards in the 2006 Rainwater and Land Development Manual. Ohio also specifies stormwater control standards in the 1980 Ohio Stormwater Control Guidebook.
Impervious Surface	N/A
Infiltration	N/A
Innovative Measures	Typical of other states
LID Requirements	N/A
LID Incentives	N/A
Redevelopment	Under General NPDES permit requirements in Appendix of 2006 manual: Redevelopment projects are required to either reduce the existing, pre-construction impervious area of the site by 20%, or capture and treat 20% of VWQ. Linear projects, which do not creation new impervious surfaces, are exempt from post-construction stormwater management requirements, although they are required to minimize the number and width of stream crossings.
Links to Language	Ohio Revised Code Chapter 6111: http://codes.ohio.gov/orc/6111 Rainwater and Land Development Manual: http://www.dnr.state.oh.us/default/water/rainwater/default/tabid/9186/Default.aspx

PENNSYLVANIA

Policy Structure	The Pennsylvania Storm Water Management Act of 1978 (Act 167) provides the legislative basis for statewide stormwater management. Stormwater management plans must be developed by the respective counties in a given watershed and be implemented by the affected municipalities through the adoption of stormwater ordinances. Pennsylvania provides design and review guidelines for stormwater management in its 2006 Pennsylvania Stormwater Best Management Practices Manual.
Impervious Surface	N/A
Infiltration	Strongly encouraged in the stormwater manual
Innovative Measures	Typical of other states
LID Requirements	N/A
LID Incentives	N/A

PENNSYLVANIA

Redevelopment	Though not required, the stormwater manual recommends the following guideline: 20 percent of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment. Ch 7 of the Stormwater manual provides guidelines for Brownfield redevelopment.
Links to Language	Pennsylvania Stormwater Management Act: http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/StormwaterMgmtAct.pdf Pennsylvania Stormwater Best Management Practices Manual and related documents: http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/stormwatermanagement/default.htm

RHODE ISLAND

Policy Structure	The State of Rhode Island recently passed An Act Relating to Towns and Cities—Establishing the Smart Development for a Cleaner Bay Act of 2007. An updated stormwater design manual, which will incorporate these requirements, is under development. These requirements will apply to any development previously subject to stormwater review, including development within MS4s under NPDES Phase I and II jurisdiction. In addition, the Coastal Resources Protection Council administers the Special Area Management Plans (SAMPs) that include more stringent stormwater and buffer requirements. The Urban Coastal Greenways Policy applies to the cities of Cranston, East Providence, Pawtucket, and Providence.
Impervious Surface	N/A
Infiltration	Maintain pre-development groundwater recharge and infiltration on site to the MEP.
Innovative Measures	Typical of other states
LID Requirements	The state requires that low impact-design techniques be used as the primary method of stormwater control to the MEP. Under the Urban Coastal Greenways Policy, development plans must be reviewed by a professional who has completed an LID training course and has received an LID Master Design Certificate. The draft stormwater manual sets Minimum Standard 1: Nonstructural and Small-Scale Upland Management, which states that nonstructural and small-scale upland management designs must be used to the fullest extent practicable in order to reduce the generation of the water quality volume. It also requires that structural control use be avoided where the water quality volume cannot be managed via nonstructural and small-scale practices (i.e., pollution hot spots).
LID Incentives	The volume required for the permanent pool of a wet pond can be reduced if rooftop runoff is infiltrated on-site. This procedure allows rooftops to be subtracted from total impervious areas, thus reducing the total amount of runoff routed to the permanent pool. Infiltration of rooftop runoff should be restricted to residential buildings or other buildings that do not have air pollution, venting, cooling, or heating equipment located on the roof.
Redevelopment	Redevelopment appears to be treated the same as new development, where only the increase in disturbance and imperviousness is required to be treated.
Links to Language	An Act Relating to Towns and Cities—Establishing the Smart Development for a Cleaner Bay Act of 2007: http://www.rilin.state.ri.us/BillText07/SenateText07/S0808Aaa.pdf Draft Rhode Island Stormwater Design & Installation Standards Manual, Chapter 4—Nonstructural and Small-Scale Upland Management: http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/pdfs/upman.pdf

VERMONT

Policy Structure	Vermont Statues Annotated (VSA) Title 10 § 1264 authorizes the creation of state stormwater permits. Chapters 18 and 22 of the Environment Protection Rules regulate the discharge of post-construction stormwater. State post-construction stormwater standards are specified in one of two general permits depending upon the condition of the receiving water – General Permits 3-9010 and 3-9015. The Vermont Stormwater Management Manual Volumes 1 and 2 describe regulatory requirements and technical guidance, respectively.
Impervious Surface	For new development and applicable redevelopment, either (a) the existing impervious surface shall be reduced by 20% or (b) a stormwater treatment system shall be designed to capture and treat 20% of the water quality volume from the existing impervious area or (c) a combination of (a) and (b) can be used such that, when combined, a minimum 20% reduction/treatment is achieved.
Infiltration	According to the Stormwater Manual Volume I, the average annual recharge rate for the prevailing hydrologic soil group(s) shall be maintained in order to preserve existing water table elevations.
Innovative Measures	Typical of other states
LID Requirements	N/A
LID Incentives	Stormwater credits are offered for the use of: • Natural Area Conservation • Disconnection of Rooftop Runoff • Disconnection of Non-Rooftop Runoff • Stream Buffers • Grass Channels • Environmentally Sensitive Rural Development
Redevelopment	Impervious surface and water quality treatment requirements apply to the portion of existing impervious surface that is redeveloped; the existing impervious surface only needs to comply with any previous permit requirements.
Links to Language	Stormwater Management Rule for Unimpaired Waters: http://www.vtwaterquality.org/stormwater/docs/sw_rule-unimpaired.pdf Stormwater Management Rule for Impaired Waters: http://www.vtwaterquality.org/stormwater/docs/sw_rule-impaired.pdf The Vermont Stormwater Management Manual Volume 1: http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_manual-vol1.pdf

VIRGINIA

Policy Structure	Stormwater management standards can be found at erosion and sediment control law [Title 10.1, Chapter 5, Article 4] and regulations [4VAC50-30] as amended by the Virginia General Assembly in July 2006. These rules establish the requirements for the state and local erosion and sediment control and storm water management programs that regulate land-disturbing activity greater than 10,000 square feet. The Chesapeake Bay Preservation Area Designation and Management Regulations [9 VAC 10-20-10 et seq.] (also known as the Bay Act), adopted in 1990 and amended in December 2001, regulate development impacts, including storm water management, within the Chesapeake Bay watershed. The Virginia Department of Environmental Quality and Department of Conservation and Recreation jointly administer the regulations. The Department of Conservation and Recreation administers the resource protection and management area regulations.

VIRGINIA

Impervious Surface	Performance-based criteria are based on a site's pre-project impervious cover compared to the average impervious cover for that land use. More stringent pollutant controls are required if the proposed development is expected to increase impervious cover over the average cover for that land use. Development is required to minimize impervious area in Resource Management Areas.
Infiltration	N/A
Innovative Measures	Typical of other states
LID Requirements	§ 10.1-603.4 of The Virginia Soil and Water Conservation Board is required by state law to: "Encourage low impact development designs, regional and watershed approaches, and nonstructural means for controlling stormwater."
LID Incentives	N/A
Redevelopment	Redevelopment is allowed in Resource Protection Areas, but no increase in imperious cover is allowed. Under Virginia Stormwater Management Regulations, local governments must enact ordinances that require redevelopment, as well as new development, to control and treat stormwater runoff beyond pre-development conditions.
Links to Language	Virginia Stormwater Management Law: http://www.dcr.virginia.gov/soil_&_water/documents/vaswmlaw.pdf Virginia Stormwater Management Regulations: http://www.dcr.virginia.gov/soil_&_water/documents/vaswmregs.pdf Virginia Stormwater Management Handbook: http://www.dcr.virginia.gov/soil_&_water/stormwat.shtml#pubs

WISCONSIN

Policy Structure	State Statute 281.16 (2) (a) authorizes the Wisconsin Department of Natural Resources (WDNR) to promulgate water quality performance standards. Under this law, WDNR established Chapter NR 151 of the state code, which contains runoff pollutant performance standards.
Impervious Surface	N/A
Infiltration	Requirements to infiltrate to the MEP a percentage of the predevelopment runoff volume; Residential 90%; Non-residential 60% or 10% of the 2-yr, 24-hour event. As a cap, no more than 2% of the site is required as an effective infiltration area. Some exemptions apply.
Innovative Measures	Typical of other states
LID Requirements	N/A
LID Incentives	N/A
Redevelopment	For all redevelopment and infill under 5 acres, BMPs are required to control to the MEP 40% of the total suspended solids that would normally run off the site based on an average annual rainfall. Infill occurring 10 or more years after Oct. 2002 is required to meet the new development standard of 80% TSS.
Links to Language	State Code Chapter NR 151—Runoff Management: http://www.legis.state.wi.us/rsb/code/nr/nr151.pdf

FEDERAL GOVERNMENT

The "Energy Independence and Security Act of 2007," which was signed into law December 19, 2007, contains a provision in Title IV, Energy Savings in Building and Industry, Subtitle C, High Performance Federal Buildings:

Sec. 438. Storm Water Runoff Requirements for Federal Development Projects.

The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.

This provision requires all Federal development and redevelopment projects with a footprint above 5,000 square feet to achieve predevelopment hydrology to the "maximum extent technically feasible." This standard may differ from the MEP standard set forth in stormwater regulations.

This provision will likely result in much more focus on LID ,with more companies interested in learning how to develop and apply "design, construction, and maintenance strategies" that preserve pre-development technology, so that they can maintain existing, or obtain new, Federal government construction contracts. Also, the establishment of these requirements for Federal facilities is expected to have the effect of "mainstreaming" LID BMPs for non-federal facilities.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN NEIGHBORHOOD DEVELOPMENT STANDARDS

The U.S. Green Building Council develops and maintains the Leadership in Energy and Environmental Design (LEED) rating systems that promote energy conservation and sustainable design within the building industry. USGBS formed a partnership with the Congress for the New Urbanism and the Natural Resources Defense Council to develop a LEED rating system at the neighborhood scale. A pilot version of the LEED for Neighborhood Development (LEED-ND) Rating System has been released by the partnership[17] that seeks to promote neighborhood designs that minimize resource consumption and pollution and achieve sustainability. The pilot program will be used to test and refine the standards before they are released for industry-wide application. Of the 238 pilot projects selected for the program, 40 projects are located in California.[18]

The ND standards are divided into four categories:

- The **Smart Location and Linkage (SLL)** category evaluates how a development's location impacts urban sprawl, resource use, and environmental impacts.
- The **Neighborhood Pattern and Design (NPD)** category evaluates the layout of the neighborhood and the extent that each use provides social and environmental benefits.
- The **Green Construction and Technology (GTC)** category evaluates the construction process and the design of the structures within the neighborhood, seeking to reduce environmental contamination and site disturbance while promoting resource conservation and energy efficiency.
- **Innovation and Design Process (IDP)** category provides credit to neighborhood projects that achieve greater innovation than what is required or credited in the rating system. This category also gives credit for the involvement of an accredited professional.

Under each category, the rating system specifies prerequisites and credits. Prerequisites are required before an applicant is eligible for the certification, and credits provide the applicant with points towards different certification levels (certification, silver, gold, and platinum).

[17] USGBC, CNU, and NRDC. 2007. Pilot Version LEED for Neighborhood Development Rating System. A Partnership of the U.S. Green Building Council (USGBS), the Congress for New Urbanism (CNU), and the Natural Resources Defense Council (NRDC). http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148.

[18] USGBC, CNU, and NRDC. 2007b. LEED for Neighborhood Development Registered Pilot Project List. A Partnership of the U.S. Green Building Council (USGBS), the Congress for New Urbanism (CNU), and the Natural Resources Defense Council (NRDC). https://www.usgbc.org/ShowFile.aspx?DocumentID=2960.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN NEIGHBORHOOD DEVELOPMENT STANDARDS

Standards that Directly Contribute to Stormwater Management

The ND standards contain a number of prerequisites and credits related to stormwater management. The following paragraphs describe each prerequisite or credit in more detail.

- **SLL Prerequisite 4: Wetland and Waterbody Conservation:** An applicant meets this standard if the site includes no land within 100 feet of wetlands or waterbodies. The standard can also be met if 1) the site is located on a previously developed site; and 2) any wetland or waterbody impacts are compensated through on-site or off-site restoration. For sites that are not previously developed and contain wetlands or waterbodies, the rating system limits the percent of on-site impacts allowed according to the street grid density of the development. The applicant is also required to retain at least 90 percent of the average annual rainfall or 1 inch of rainfall from 75 percent of the development footprint within the impacted area. Retention methods must infiltrate, reuse, or provide for the evapotranspiration of the rainfall amount. This standard contributes to stormwater management by reducing the impact to the natural hydrology and water quality functions of a development site.
- **SLL Prerequisite 6: Floodplain Avoidance:** Similar to the above prerequisite, the Floodplain Avoidance standard is met if the site does not contain any land within the 100-year floodplain. The standard is also met if the site is located on an infill or previously developed site and the National Flood Insurance Program (NFIP) requirements are followed when developing land within the 100-year floodplain. For sites that do not meet these conditions, the standard can only be met if land within the 100-year floodplain is not developed. This standard contributes to stormwater management by reducing the impact to the natural hydrology and water quality functions of a development site.
- **SLL Credit 8: Steep Slope Protection:** This standard provides credit for either avoiding development on steep slopes or restoring vegetation to previously developed steep slopes. Credit is provided according the severity of the slopes and the proportion of steeped sloped land that is protected or restored. An exemption is included for steep slopes that are isolated by more than 30 feet from other steeply sloped areas. This standard contributes to stormwater management by reducing the runoff and erosion generated on steep slopes during storm events.
- **SLL Credits 9, 10 and 11: Habitat or Wetland Conservation:** These standards provide credits for habitat or wetland conservation on the development site. To receive credit under SLL Credit 9, the applicant must inquire with a state's Natural Heritage program and other wildlife or fish agencies to determine whether significant habitat exists on the development site. The applicant must protect in perpetuity the habitat and an appropriate buffer, as delineated by a qualified professional. For previously developed sites, the applicant can receive credit for using native plants for 90 percent of the site vegetation and refraining from the use of invasive plants. The standard also provides credit for conserving wetlands and waterbodies and planning buffers around the development footprint to protect water quality, habitat, and hydrologic functions. SLL Credit 10 provides credit for habitat or wetlands restoration on an area equal to or greater than 10 percent of the development. Invasive species removal is required to achieve credit for restoration. SLL Credit 11 provides credit for developing a long-term management plan for on-site habitat, wetlands, or waterbodies. Through the conservation of habitat and wetland areas, these standards contribute to stormwater management by preserving pervious areas, natural drainage paths, and other areas that maintain pre-development hydrology and water quality functions.
- **NPD Credit 6: Reduced Parking Footprint:** This standard provides credit for limiting surface parking and using multistory or underground parking, carpool spaces, and bicycle parking. To receive credit, the applicant must limit surface parking facilities to no more than 20 percent of the total development footprint. The intent of the credit is to reduce the negative social and environmental impacts of parking areas. This standard contributes to stormwater management through reduction of impervious surface.
- **GCT Credit 6: Minimize Site Disturbance through Site Design:** Under this standard, an applicant can receive credit for preserving, in perpetuity, undeveloped land, including tree canopy, native vegetation, and pervious surfaces. The credit award depends on the extent of pervious development on the site and the planned density of the site. This standard contributes to stormwater management by reducing the impact to the natural hydrology and water quality functions of a development site.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN NEIGHBORHOOD DEVELOPMENT STANDARDS

- **GCT Credit 7: Minimize Site Disturbance during Construction:** This standard provides credit for establishing limits of disturbance for natural areas or preserving significant trees on the site. The standard contains specific distances required for the limits of disturbance as well as the type of trees that qualify for preservation credit. This standard contributes to stormwater management by reducing the impact to the natural hydrology and water quality functions of a development site.
- **GCT Credit 9: Stormwater Management:** This standard provides credit for applicants who implement a comprehensive stormwater management plan. The plan must effectively retain a specified amount of rainfall from the project's development footprint. The rainfall amounts vary by the humidity of the watershed's climate; developments in more humid watersheds are required to retain a greater rainfall amount than more arid watersheds. The applicant can receive from 1 to 5 points depending on how much rainfall is retained. Retention methods must infiltrate, reuse, or provide for the evapotranspiration of the rainfall amount. This standard contributes to stormwater management by reducing the stormwater runoff generated by development.

Additional Standards that Contribute to Stormwater Management

In addition to the above standards, the ND rating system contains several prerequisites and credits that more directly target smart growth and air quality goals but contribute to stormwater management in the process. Many of the credits relating to smart growth may contribute to reduced impervious surface, provided that undeveloped land is conserved in the process. Several credits promote infill and brownfield development, which decreases pressure on undeveloped land and ultimately leads to reduced stormwater impacts. Several standards promote compact development, which could lead to improved stormwater management if stormwater is controlled and treated and the compact development conserves undeveloped land in other locations. The ND standards that target automobile dependency could lead to reducing transportation-related pollutant loading as well.

Appendix C: Key Elements of Progressive Ordinances

DEVELOPMENT OF STORMWATER MANAGEMENT GOALS AND OBJECTIVES

In the case study areas, often draft goals and objectives were used to help develop stormwater management criteria and craft "scenarios" to test in watershed modeling and/or pilot-project development. Local advisory groups or boards were used to help draft the preliminary goals and objectives.

Clearly, different communities have different goal and objective statements depending on local circumstances and requirements. For example, some communities may only wish to meet Phase II requirements, while others may set higher goals than state minimum requirements due to local concerns, such as drinking water supply or habitat protection. Following are examples of goals and objectives statements from several of the case study communities. Examples 1 and 2 draw on general police powers granted local governments: protect, maintain and enhance the public health, safety, and welfare. Example 3 goes further to establish a local non-degradation goal. Finally, Example 4 sets the highest goal: maintaining and improving existing water quality.

Example Goals Statements

Example 1 (modified from Town of Chapel Hill's Land Use Management Ordinance)

"The purpose of this section is to establish minimum stormwater management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within this jurisdiction. This ordinance seeks to meet that purpose through the following objectives:"

Example 2 (from Charlotte-Mecklenburg Post-Construction Storm Water Ordinance, draft under public review)

"The purpose of this ordinance is to protect, maintain and enhance the public health, safety, environment and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased post-development storm water runoff and non-point source pollution associated with new development and redevelopment. It has been determined that proper management of construction related and post-development storm water runoff will minimize damage to public and private property and infrastructure, safeguard the public health, safety, and general welfare, and protect water and aquatic resources."

Example 3 (modified from the Town of Huntersville Water Quality Ordinance)

"The purpose of this regulation is to establish stormwater management requirements and controls to prevent surface water quality degradation to the extent practicable in the streams and lakes within the Town Limits and Extraterritorial Jurisdiction of Huntersville and to protect and safeguard the general health, safety, and welfare of Huntersville's residents. This regulation seeks to meet this purpose by fulfilling the following objectives:"

Example 4 (modified from the City of Portland's Stormwater Management Ordinance)

"The purpose of this Stormwater Management Ordinance is to provide for the effective management of stormwater and drainage and to maintain and improve water quality in the watercourses and waterbodies within and leaving the City. This ordinance seeks to meet that purpose through the following policies and standards:"

Example Objectives Statements

Example 1 – City of Charlotte-Mecklenburg County (Note all municipalities within Mecklenburg County worked jointly with the County to develop a unified post-construction ordinance, which is currently under public review.)

"This ordinance seeks to meet its general purpose through the following specific objectives and means:

1. Establishing decision-making processes for development that protect the integrity of watersheds and preserve the health of water resources.
2. Requiring that new development and redevelopment maintain the pre-development hydrologic response in their post-development state as nearly as practicable for the applicable design storm in order to reduce flooding, streambank erosion, non-point and point source pollution and increases in stream temperature, and to maintain the integrity of stream channels and aquatic habitats.
3. Establishing minimum post-development storm water management standards and design criteria for the regulation and control of storm water runoff quantity and quality.
4. Establishing design and review criteria for the construction, function, and use of structural storm water control facilities that may be used to meet the minimum post-development storm water management standards.
5. Encouraging the use of better management and site design practices, such as the preservation of greenspace and other conservation areas, to the maximum extent practicable.
6. Establishing provisions for the long-term responsibility for and maintenance of structural and nonstructural storm water BMPs to ensure that they continue to function as designed, are maintained appropriately, and pose no threat to public safety.
7. Establishing administrative procedures for the submission, review, approval and disapproval of storm water management plans, for the inspection of approved projects, and to assure appropriate long-term maintenance."

Example 2 – (adapted from Town of Huntersville Water Quality Ordinance and from Town of Chapel Hill Land Use Management Ordinance)

a. "Minimize increases in storm water runoff from development or redevelopment in order to reduce flooding, siltation and streambank erosion, and maintain the integrity of stream channels;
b. Minimize increases in nonpoint source pollution caused by stormwater runoff from development or redevelopment that would otherwise degrade local water quality;
c. Minimize the total volume of surface water runoff that flows from any specific site during and following development in order to replicate pre-development hydrology to the maximum extent practicable;
d. Reduce stormwater runoff rates and volumes, soil erosion and nonpoint source pollution, to the extent practicable, through stormwater management controls (BMPs) and ensure that these management controls are properly maintained and pose no threat to public health or safety; and
e. Meet the requirements of the National Pollution Discharge Elimination System (NPDES) Storm Water Permit and other requirements as established by the Clean Water Act."

Example 3 – Policies and Standards (adapted from City Code, City of Portland, Oregon)

The City of Portland code lists policies rather than objectives.

a. "Stormwater shall be managed as close as is practicable to development sites, and stormwater management shall avoid a net negative impact on nearby streams, wetlands, groundwater, and

other waterbodies. All local, state, and federal permit requirements related to implementation of stormwater management facilities must be met by the owner/operator prior to facility use. Surface water discharges from onsite facilities shall be conveyed via an approved drainage facility.

b. The quality of stormwater leaving the site after development shall be equal to or better than the quality of stormwater leaving the site before development, as much as is practicable.

c. The quantity of stormwater leaving the site after development shall be equal to or less than the quantity of stormwater leaving the site before development, as much as is practicable."

As shown in the above examples, the goal or purpose statement is very general. The objectives provide more detail on what implementation of the ordinance is intended to accomplish. The objectives can be regulatory based (e.g., meet Phase II requirements), resource based (e.g., minimize increases in nonpoint source pollution), or both. Importantly, the goals and objectives set the stage for selecting appropriate performance standards and criteria, and for encouraging LID.

PERFORMANCE CRITERIA ENCOURAGING LID TECHNIQUES

The examples below reflect key elements of progressive stormwater programs' approaches to using performance criteria to encourage LID.

Example 1 – Huntersville, North Carolina's Performance Standards

The Town of Huntersville is a developing community of about 35,000 residents and part of a regional commuter rail system planned for the metropolitan area. The town has experienced a rapid conversion from a farming community to a developing residential and commercial area. In February 2002, The Town of Huntersville adopted a moratorium on the approval of new major development plans. The moratorium allowed the town to focus on writing zoning ordinance amendments that would protect the Town's rural character and open space while allowing for high density and mixed-use development in centralized locations. Huntersville's updated zoning ordinance established 15 zoning districts.

Huntersville protects open space in the rural residential, transitional residential, and traditional neighborhood-rural districts. In these districts, permitted density depends on the amount of open space preserved. The transitional zoning district doubles the density allowed per open space percentage compared to the rural districts, but a minimum of 25 percent open space is required

The updated ordinance provides incentives for developers to dedicate permanent conservation easements. Termed conservation subdivisions, these developments will preserve the rural appearance of the land when viewed from public roads and adjacent properties. In turn, the developments are exempt from lot frontage, sidewalk, planting, and other requirements. The preservation of existing, mature trees is emphasized in the conservation easement provisions.

The Huntersville zoning districts include several mixed-use and residential districts designed to encourage quality of life and convenient access to employment and services. These districts include the Neighborhood Residential, Neighborhood Center, Town Center, and Transit-Oriented districts. Automobile-oriented and industrial developments are restricted to other zoning districts so that the Town can develop pedestrian-friendly town and neighborhood centers. These zoning districts were designed to encourage convenient walking distances between residential and commercial uses. Three zones allowing varying development intensity were designated (see Figure A-1).

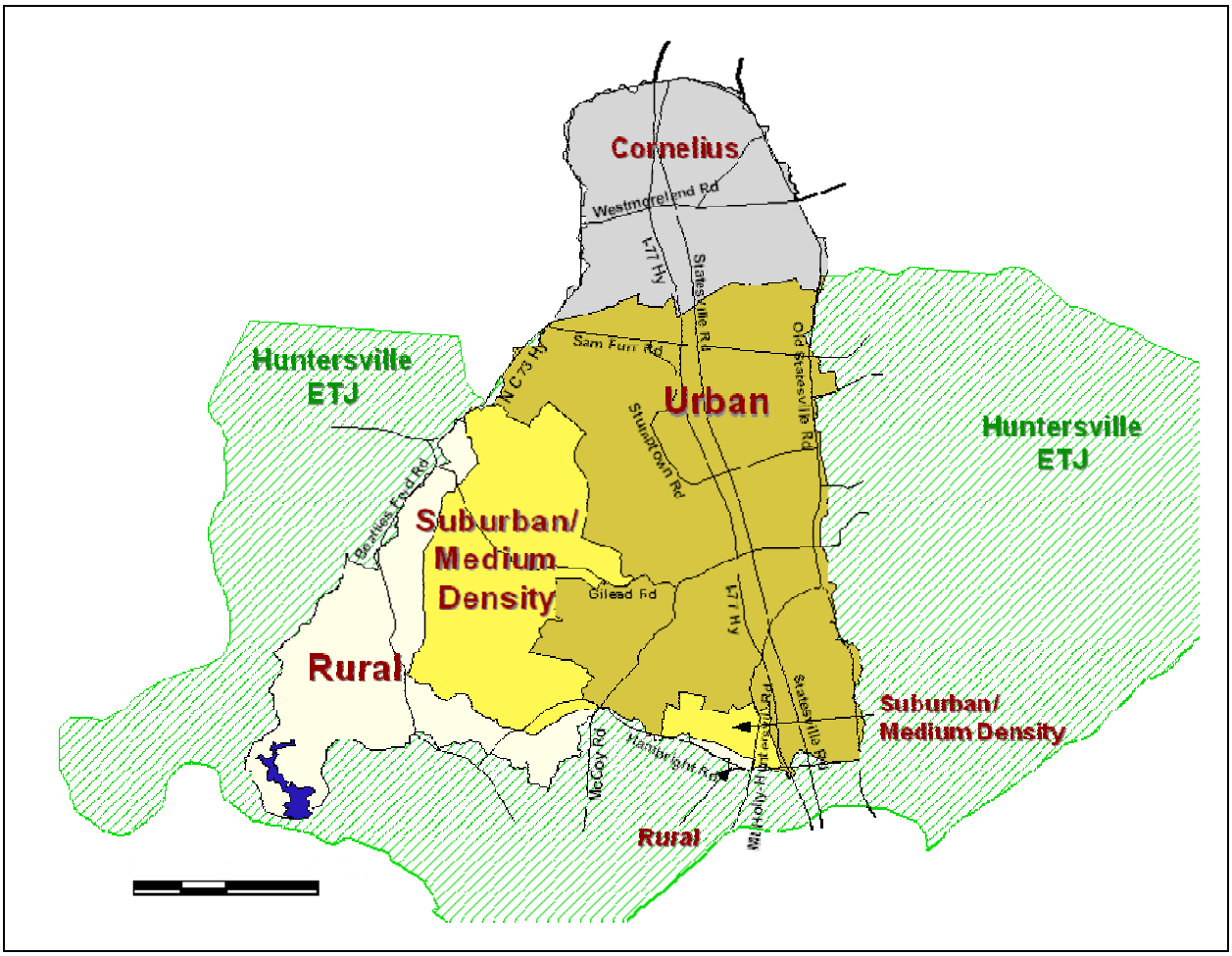

Figure A-1. Town of Huntersville's Development Zones

Huntersville included water quality measures in its ordinance, and adopted a water quality goal of no future degradation. The Town analyzed the water quality and hydrology benefits of alternative performance standards as well as the estimated cost to the landowner or developer in meeting the performance criteria and to build understanding about the cost implications of adopting more protective stormwater requirements in the Town's Ordinance. After that analysis, the Town adopted the following performance standards and required the use of LID in meeting these standards.

a. "All stormwater treatment systems used to meet these performance criteria shall be designed to achieve average annual 85 percent Total Suspended Solids (TSS) removal for the developed area of a site. Areas designated as open space that are not developed do not require stormwater treatment. All sites must employ LID practices to control and treat runoff from the first inch of rainfall.

b. LID practices or a combination of LID practices and conventional stormwater management practices shall be used to control and treat the increase in stormwater runoff volume associated with post-construction conditions as compared with pre-construction (existing) conditions for the 2-yr frequency, 24-hr duration storm event in the Rural and Transitional Zoning Districts. All other zoning districts shall meet this standard for the 1-yr frequency, 24-hr duration event.

c. Where any stormwater BMP employs the use of a temporary water quality storage pool as a part of the treatment system, the drawdown time shall be a minimum of 48 hours and a maximum of 120 hours.

d. Peak stormwater runoff rates shall be controlled for all development above 12 percent imperviousness (for the 2-yr, 24-hr and the 10-yr, 24-hr storm events). The emergency overflow and outlet works shall be capable of safely passing a discharge with a minimum recurrence frequency of 50 years.

e. No one BMP shall receive runoff from an area greater than 5 acres."

The town's Open Space performance standards are shown in Table A-1. Note that both the open space and water quality performance standards vary by planning district to meet the Town's overall smart growth objectives.

To ease overall administration and to ensure accountability, the Town developed a Stormwater BMP Design Manual and a Site Evaluation Tool that developers are required to use in project design and documenting compliance with the performance standards. (See Program Administration for more information on the Site Evaluation Tool).

Table A-1. Open Space and Density Requirements for Huntersville's Rural Residential and Traditional Neighborhood-Rural Zoning Districts

Amount of Open Space Provided	Density Permitted
0% unless tract is within a proposed greenway in which case the greenway shall be designated as open space	0.33 units per Adjusted Tract Acreage
25% - 29.9% Open Space	0.4 units per Adjusted Tract Acreage
30% - 34.9% Open Space	0.6 units per Adjusted Tract Acreage
35% - 39.9% Open Space	0.8 units per Adjusted Tract Acreage
40% - 44.9% Open Space	1.0 unit per Adjusted Tract Acreage
45%+ Open Space	1.2 units per Adjusted Tract Acreage

The performance standards required by the Town of Chapel Hill are similar to the Huntersville standards, with the following exceptions: Chapel Hill requires volume control for the 2-yr, 24-hr storm event throughout its jurisdiction. The stormwater runoff rate is controlled for the 1-, 2-, and 25-yr, 24-hr storm event (rather than the 2-yr and 10-yr storm events). The Town of Chapel Hill encourages rather than requires LID to meet its performance standards.

Each of the programs described above stipulates certain activities or types of development that are exempt from the guidelines and regulations described above. Those regulatory exemptions are as follows:

Town of Huntersville: Any new development, redevelopment or expansions that include the creation or addition of less than 5,000 sq ft of new imperviousness.

Town of Chapel Hill: Single family and two family developments and redevelopments that do not disturb more than 5,000 sq ft of land area, provided they are not part of a larger common development plan, are exempted.

Example 2 – City of Charlotte, NC and Mecklenburg County

The Charlotte-Mecklenburg Post-Construction Storm Water Ordinance (draft under public review) divides the County into five districts, each having unique performance standards. As discussed below, the performance standards necessitate the use of LID in order to meet the standards on site.

One of the first items agreed to by the stakeholders' group helping to guide development of the post-construction ordinance was the need to divide Mecklenburg County into districts. It was decided that a one size fits all approach was not appropriate, but instead districts should be drawn based upon need for protection and other criteria. An example of one of the criteria used was the presence of a federally endangered species in Goose Creek District and the Yadkin-Southeast Catawba District, which resulted in more stringent controls on new development. Areas with a very high percentage of existing development (i.e., the City of Charlotte) resulted in less stringent controls in new development. Figure A-2 shows the configuration of the districts, which were drawn along watershed boundaries. Other factors, such as close proximity to drinking water reservoirs, resulted in more stringent levels of control. Recognizing that certain areas in Mecklenburg County had unique characteristics and needs, the stakeholder group then debated basic criteria that would provide the foundation of the ordinance and meet the goals and objectives. The main categories for new performance standards were:

- Structural Water Quality BMPs: These controls are intended to remove water quality pollutants from stormwater runoff. The ordinance targets Total Phosphorus (TP) and Total Suspended Solids (TSS).
- Stream Buffers: These controls require that areas directly adjacent to streams be set aside as natural areas. Limited disturbance many be allowed depending on the distance from the stream.
- Volume and Peak Control: The controls require that the additional stormwater runoff volume and peak flow rates generated by land development activities be held back and released slowly over time so as to not cause downstream erosion and flooding.
- Open Space Requirements: These controls require that a certain percentage of a developed site be preserved as undisturbed area unless mitigation is provided.

Each District has a unique combination of these controls, depending on the level of protection needed. (See Table A-2, Summary of Performance Criteria for the Charlotte-Mecklenburg Post Construction Ordinance). It is important to note, however, that the performance standard for phosphorus removal (70 percent removal for runoff from the first inch of rainfall) applies to 4 of the 5 districts and necessitates the use of a treatment train approach using LID techniques in order to meet this standard onsite. The TP performance standard was based on an evaluation of streams in the County and loading rates needed to support designated uses (including healthy aquatic communities).

Because meeting the TP performance standard can be quite expensive for developments with high imperviousness (much more expensive on a cost per pound removed basis than developments with lower imperviousness), the Ordinance allows a flexible "buy down" option from 70 percent TP removal to 50 percent removal, and allows the City or County to use the revenue to construct BMP retrofits offsite to "make up the difference" in phosphorus loading. To reduce the cost of meeting the open space requirements, the Ordinance has offsite mitigation and onsite mitigation techniques, as well as payment-in-lieu.

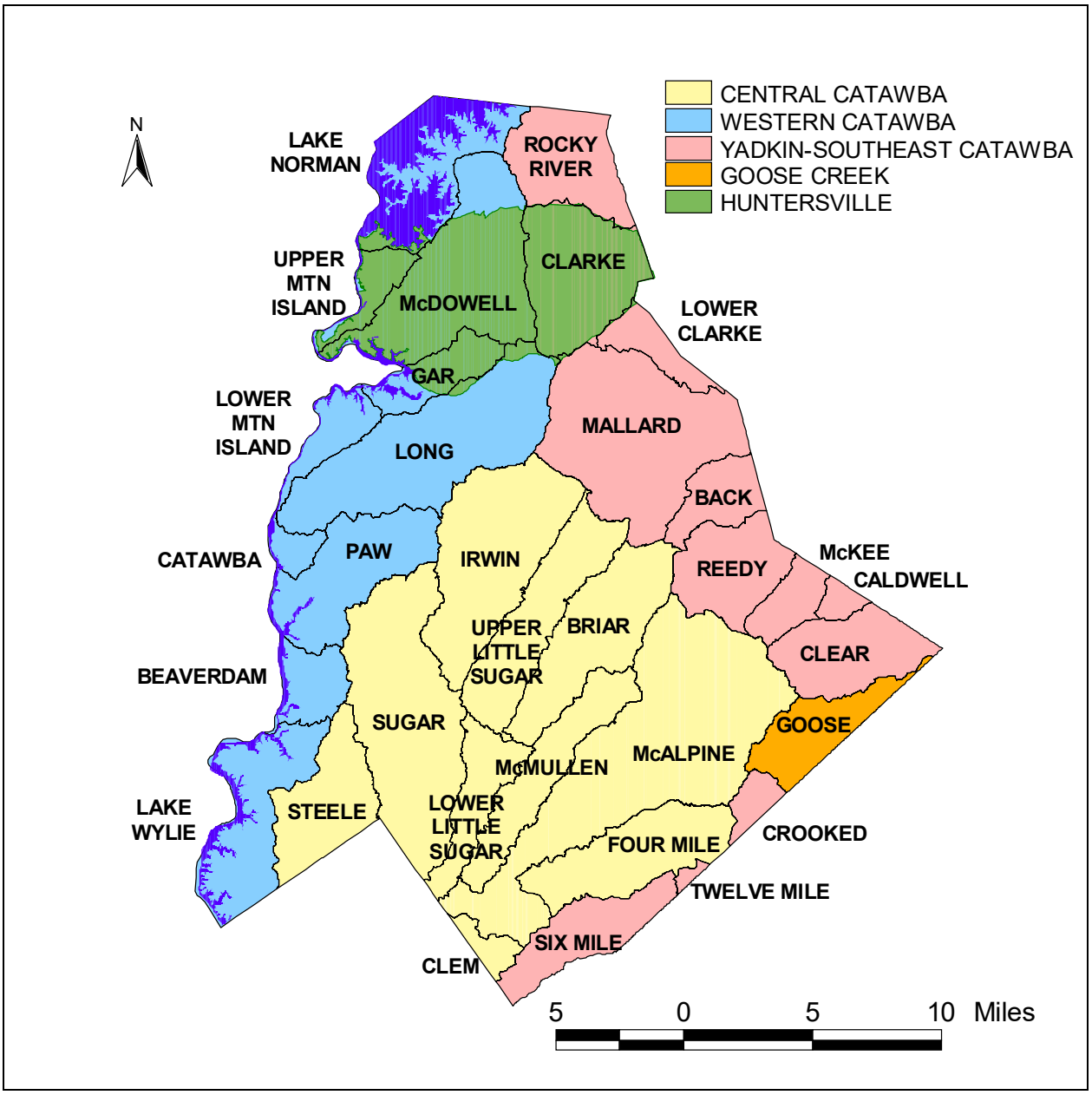

Figure A-2. Watershed Districts for Charlotte Mecklenburg Post Construction Ordinance

Table A-2. Summary of Performance Criteria for the Post-Construction Ordinance

Watershed District	Structural Water Quality BMPs	Buffers[1]	Volume & Peak Control	Open Space Requirements
Central Catawba	>24% BUA requires 85% TSS removal for runoff from 1st inch of rainfall; LID optional	30 ft. no build zone on intermittent and perennial streams draining < 50 acres 35 ft. (2 zones) on perennial streams draining <300 acres 50 ft (3 zones) on streams draining ≥300 acres 100 ft + 50% of floodfringe on streams draining ≥640 acres	Volume (Commercial & Residential): >24% BUA control entire volume for 1-yr, 24-hr storm Peak for Residential: >24% BUA perform a downstream flood analysis to determine whether peak control is needed and if so, for what level of storm frequency (i.e., 10, 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms Peak for Commercial: >24% BUA control the peak for the 10-yr, 6-hr storm **AND** perform a downstream flood analysis to determine whether additional peak control is needed and if so, for what level of storm frequency (i.e., 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms	Open space is undisturbed area <24% BUA = 25% open space ≥24% and <50% BUA = 17.5% open space ≥50% BUA = 10% open space
Western Catawba	>12% BUA requires 85% TSS and 70% TP removal for runoff from 1st inch of rainfall; LID optional; BUA area caps apply in water supply watersheds	30 ft. no build zone on intermittent and perennial streams draining < 50 acres 35 ft. (2 zones) on perennial streams draining <300 acres 50 ft (3 zones) on streams draining ≥300 acres 100 ft + 50% of floodfringe on streams draining ≥640 acres	Volume (Commercial & Residential): >12% BUA control entire volume for 1-yr, 24-hr storm Peak for Residential: >12% BUA perform a downstream flood analysis to determine whether peak control is needed and if so, for what level of storm frequency (i.e., 10, 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms Peak for Commercial: >12% BUA control the peak for the 10-yr, 6-hr storm **AND** perform a downstream flood analysis to determine whether additional peak control is needed and if so, for what level of storm frequency (i.e., 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms	Same as Central Catawba
Yadkin-Southeast Catawba	>10% BUA requires 85% TSS and 70% TP removal for runoff from 1st inch of rainfall; LID optional	50 ft undisturbed forested buffers on intermittent and perennial streams draining < 50 acres 100 ft undisturbed forested buffers plus remainder of floodplain on perennial and intermittent streams draining	Volume (Commercial & Residential): >10% BUA control entire volume for 1-yr, 24-hr storm Peak for Residential: >10% BUA perform a downstream flood analysis to determine whether peak control is needed and if so, for what level of storm frequency (i.e., 10, 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms	Same as Central Catawba

Table A-2. Summary of Performance Criteria for the Post-Construction Ordinance

Watershed District	Structural Water Quality BMPs	Buffers[1]	Volume & Peak Control	Open Space Requirements
		≥ 50 acres	Peak for Commercial: >10% BUA control the peak for the 10-yr, 6-hr storm **AND** perform a downstream flood analysis to determine whether additional peak control is needed and if so, for what level of storm frequency (i.e., 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms	
Goose Creek	>6% BUA requires 85% TSS and 70% TP removal for runoff from 1st inch of rainfall; LID optional; 24% BUA cap on single family residential, 50% on all other development	100 ft. undisturbed forested buffer on perennial and intermittent streams draining < 50 acres 200 ft. undisturbed forested buffer plus remainder of floodplain on perennial and intermittent streams draining ≥ 50 acres	Volume (Commercial & Residential): >6% BUA control entire volume for 1-yr, 24-hr storm Peak for Residential: >6% BUA perform a downstream flood analysis to determine whether peak control is needed and if so, for what level of storm frequency (i.e., 10, 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms Peak for Commercial: >6% BUA control the peak for the 10-yr, 6-hr storm **AND** perform a downstream flood analysis to determine whether additional peak control is needed and if so, for what level of storm frequency (i.e., 25, 50 or 100-yr, 6-hr) **OR** if a downstream analysis is not performed control the peak for the 10-yr and 25-yr, 6-hr storms	Same as Central Catawba
Huntersville	For developments with greater than or equal to 5,000 square feet of BUA, install LID practices to achieve 85% TSS removal for runoff from the 1st inch of rainfall; BUA area caps apply in water supply watersheds	30 ft. no build zone on intermittent and perennial streams draining < 50 acres[2] 35 ft. (2 zones) on perennial and intermittent streams draining <300 acres 50 ft. (3 zones) on streams draining ≥300 acres 100 ft. or entire floodplain on streams draining ≥640 acres	Volume: For developments with greater than or equal to 5,000 square feet of BUA, control increase in volume for 1-yr, 24-hr storm or 2-yr, 24-hr storm, depending on zoning district Peak: >12% BUA control 2-yr & 10-yr, 24-hr storm	Varies by zoning district

[1] Water supply watershed buffer requirements apply in the Western and Huntersville districts. These buffers are sometimes more restrictive than the S.W.I.M. buffer requirements, in which case the watershed buffers would apply.

[2] Will require a change to the existing Huntersville Ordinance in order to comply with minimum Phase II Post-Construction rules.

Rockdale County, GA combines the Charlotte-Mecklenburg County and Town of Huntersville approaches. Based on its watershed study, the county established performance standards for new development by planning district:

- *Urban Area.* 56 percent removal TP, 78 percent removal TSS, 57 percent removal Copper. These standards must be met by new developments in the City of Conyers (existing municipal jurisdiction and planned, long-term sewer service area).
- *Suburban/Rural Area*. 52 percent removal TP, 72 percent removal TSS, 51 percent removal Copper. These standards must be met by new developments in the county jurisdiction, excluding the drinking water supply watershed and urban area.
- *Rural Residential (Water Supply Watershed) Area.* 1 unit / 3 acres.

Rockdale County encourages LID in meeting these standards.

Each of the programs described above stipulates certain activities or types of development that are exempt from the guidelines and regulations described above. Those regulatory exemptions are as follows:

- *Charlotte-Mecklenburg, NC.* Residential development that cumulatively disturbs less than one acre and cumulatively creates less than 24% built upon area based on lot size or the lot is less than 20,000 square feet; commercial and industrial development that cumulatively disturbs less than one acre and cumulatively creates less than 24% built upon area based on lot size or the lot is less than 20,000 square feet; redevelopment that disturbs less than 20,000 square feet, does not decrease existing stormwater controls, and renovation costs do not exceed 100% of the tax value of the property; common law vested right established.
- *Rockdale County, GA.* Any development or redevelopment less than 7 percent imperviousness is exempted from enhanced volume control. Otherwise, GA Phase II stormwater control thresholds apply.

Example 3 - Portland, Oregon

The City of Portland's Sewer Development Services Administrative Rules require that the City's Bureau of Environmental Services (BES) review building permits during building plan reviews for compliance with the City's Stormwater Management Manual. Adopted in September 2004, the Stormwater Manual has the following performance criteria.

"The quality of stormwater leaving the site after development shall be equal to or better than the quality of stormwater leaving the site before development, as much as is practicable, based on the following criteria:

a. Water quality control facilities required for development shall be designed, installed and maintained in accordance with the Stormwater Management Manual, which is based on achieving at least 70 percent removal of the Total Suspended Solids from the flow entering the facility for the design storm specified in the Stormwater Management Manual.

b. Land use activities of particular concern as pollution sources shall be required to implement additional pollution controls, including, but not limited to, those management practices specified in the Stormwater Management Manual.

c. Development in a watershed that drains to streams with established Total Maximum Daily Load limitations, as provided under the Federal Clean Water Act, Oregon Law, Administrative Rules, and other legal mechanisms shall assure that water quality control facilities meet the requirements for pollutants of concern, as stated in the Stormwater Management Manual."

d. Note: additional criteria follow related to implementing these criteria onsite or on an offsite facility. Otherwise, there is an option for payment in lieu.

"The quantity of stormwater leaving the site after development shall be equal to or less than the quantity of stormwater leaving the site before development, as much as is practicable, based on the following criteria:

a. Development shall mitigate all project impervious surfaces through retention and onsite infiltration to the maximum extent practicable. Where onsite retention is not possible, development shall detain stormwater through a combination of provisions that prevent an increased rate of flow leaving the site during a range of storm frequencies as specified in the Stormwater Management Manual.

b. The Director may exempt areas of the City from the requirement a. above if flow control is not needed or desirable and if stormwater is discharged to a large waterbody directly through a private outfall or if stormwater is discharged to a waterbody directly through a separated public storm sewer having adequate capacity to convey the additional flow.

c. Any development that contributes discharge to a tributary to the Willamette River shall design facilities such that the rate of flow discharging from water quantity control facilities for up to the two-year storm does not lengthen the period of time the channel sustains erosion-causing flows, as determined by the Bureau. (Note: This criterion is required due to evidence of excessive stream bank erosion and channel erosion in most tributary streams in Portland.)

d. Facilities shall be designed to safely convey the less frequent, higher flows through or around facilities without damage.

"Note: additional criteria follow related to implementing these criteria onsite or on an offsite facility. Otherwise, there is an option for payment in lieu. The City also provided incentives for reduction of stormwater runoff and impervious area through stormwater discounts.

"Regulatory Exemptions:

"Developments less than 15,000 sq.ft. are exempted from detention (devices with orifices); development less than 500 sq.ft. is exempted from retention."

The City is currently revising its Stormwater Management Manual and will release the updated manual in late fall 2007. The revisions are intended to clarify the intent of the current standards.

Example 4 – Grand Rapids, Michigan

The city of Grand Rapids, Michigan is introducing an analytic method for calculating the amount of stormwater impacts prevented by installation of higher floor area ratios. The rationale for the policy is that, although higher density development will have a greater percentage of impervious area per acre of development, the total impervious area per residence actually will be less. This overall watershed benefit is typically not recognized in site level hydrology assessments.

The runoff reduction of a higher density project is estimated by subtracting from one, the ratio of the site's actual impervious area (AIsite) divided by the impervious area (AiLD) of a low density development having the same number of units, and converted to a percentage.

Percent Runoff Reduction = (1 – AIsite / AiLD) x 100%

The city established a performance standard of 80 percent reduction of runoff based on the performance of a vegetated roof. The city then used the same 80 percent (80%) runoff reduction as the threshold for the granting of a waiver for high density developments. The city evaluated the typical impervious surface coverage of lower density development, as shown in 0.

Table A-3. Typical Impervious Area Values for Low Density Development Types

Low Density Development Type	Average Impervious Area	Development Unit
Residential	4,700 square feet	Residence
Parking Lot	275 square feet	Park-Loading Space
Office/Commercial	1 square foot	Gross Floor Area

The analysis showed that the reduction rates allow a waiver when the follow intensity is met:

- Residential projects – 38 units/acre (compared to 5 units per acre as the low density complement)
- Parking – 744 spaces per acre or a 5-deck or higher parking structure
- Office/Commercial – Floor area ratio of 5 floors or higher

Note that the analysis did not take into account related offsite public impervious surfaces such as sidewalks, access lanes and street frontage. Because higher density development projects have smaller frontage lengths, the roadway length serving the site is less (Lemoine, to be published October 2007).

Example 5 - San Jose, California

In a 2001 Order to its co-permittees, the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) modified its C.3. regulatory requirements related to new and redevelopment. (The C.3 requirements are contained in the San Francisco Regional Water Quality Board's permit and deal with stormwater treatment).

The 2001 Order required changes to the Urban Runoff Management Plan, including some of the following elements:

- *Performance Standard Implementation*. Use planning and outreach programs to help implement the new requirements.
- *Development Project Approval Process*. Modify project review processes to incorporate new requirements. The order recommended incorporation of :
  - *Site design measures.* Address the generation of excess impervious surface coverage through site and neighborhood planning. Examples cited in the 2001 Order include minimizing land disturbance, minimizing impervious surfaces (e.g., roadway width, driveway area), minimum-impact street design (e.g., neo-traditional street design standards), and parking lot design standards.
  - *Source control measures.* Prevent stormwater pollution by mitigating pollutant loading from certain uses, such as restaurants, automobile services, and landscaping.
  - *Treatment measures.* Integrate measures into site and development plans to infiltrate or filter stormwater.
- *Limitation on Increase of Peak Stormwater Runoff Discharge Rates.* Hydrograph Modification Management Plans (HMMP) was introduced to limit discharge rates. The 2001 Order recognized that certain projects, such as transit villages, may not be able to meet all of the performance standards, but since most transit villages occur in already-developed areas, the redevelopment would be unlikely to change the stormwater characteristics of the site.
- *Waiver Based on Impracticability and Compensatory Mitigation.* The 2001 Order requires that the co-permittees establish a definition for impracticability or infeasibility, and a process to

decide which alternative compliance measures could be incorporated into the site design or decision-approval process for new development and significant redevelopment projects.

- *Update General Plans.* The order recommends looking at large scale plans for opportunities to minimize the impacts of stormwater runoff at the regional or watershed scale.

In response to the revised permit, the city of San Jose sought to incorporate the new guidance into a local stormwater ordinance that would work in concert with other rules and its long-term Visioning Plan (the 2020 Plan), as well as other smart growth initiatives.

San Jose developed rules specifying that all new and redevelopment projects had to implement Post-Construction Best Management Practices (BMPs) and Treatment Control Measures (TCMs) to the maximum extent practicable. San Jose structured its policy so that deviations from the standard requirements could be established through a finding of impracticality. San Jose's policy includes some of the more common challenges, such as soil type or legacy pollutants. The city echoed the regional policy of favoring landscape-based controls, such as biofiltering and swales. However, the city also recognized some urban areas with site constraints can make landscaped-based controls expensive or impossible for the types of projects that deliver a range of economic, housing and transportation benefits.

The San Jose policy allows flexibility and several alternative measures that complement smart growth projects. First, a project can participate in a regional or shared TCM. Instead of requiring each and every project to address its own stormwater onsite, a shared TCM can lower costs and make more efficient use of land in urban areas. The city also established a category of projects called "Water Quality Benefit Projects." According to the policy:

> "Water Quality Benefit Project – In its discretion, the City may find that Smart Growth Projects provide equivalent water quality benefit. For other projects the City may find equivalent stormwater benefits where the project sponsor provides project and/or environmental documentation showing the development of the site itself, the nature of the site design, its location in the watershed, and/or proposed change in use protects/enhances water quality."

Further, the city defined "Smart Growth Projects" as a project meeting one or more of the following criteria:

a. Significant Redevelopment Project within the Urban Core

b. Low-income, moderate income, or senior housing Development Project, meeting one of the criteria listed in other sections of the city's code

c. Brownfields Projects.

For more information, see the Santa Clara Valley Urban Runoff Pollution Prevention Program (http://www.scvurppp.org/). Also, in 2007, SCVURPPP issued an update of the Guidelines of Site Design Examples. The guidebook presents examples of built projects, BMPs and a description of BMP design. See http://www.scvurppp-w2k.com/pdfs/0607/SC_Site_Design_Manual_Final_0207.pdf . The San Jose 2020 General Plan can be found at http://www.sanjoseca.gov/planning/gp/2020_text/index_htm.htm.

Example 5 – Palo Alto, California

Within the Zoning Chapter related to Off Street Parking and Loading Regulations, the city has adopted the following language:

> "Automobile and bicycle parking requirements prescribed by this chapter may be adjusted by the director of planning and community environment in the following instances and in accord with the prescribed limitations, when in his/her opinion such adjustment will be in accord with the purposes of this chapter and will not create undue

> impact on existing or potential uses adjoining the site or in the general vicinity. (f) Transportation and Parking Alternatives. Upon demonstration to the director of planning and community environment that effective alternatives to automobile access are in effect, the director of planning and community environment may defer by not more than twenty percent the parking requirement otherwise prescribed for any use, or combination of uses on the same or adjoining sites, to an extent commensurate with the permanence, effectiveness, and the demonstrated reduction of off-street parking demand effectuated by such alternative programs. Land area required for provision of deferred parking stalls shall be maintained in reserve and shall be landscaped pursuant to a plan approved by the architectural review board demonstrating that ultimate provision of the deferred stalls will meet all requirements of this chapter. The director of planning and community environment shall set such conditions as necessary to guarantee provision of such deferred stalls whenever the building official determines the need to exist. Alternative programs which may be considered by the director of planning and community environment under this provision include, but are not limited to the following: (1) Immediate proximity to pubic transportation facilities serving a significant portion of residents, employees, and/or customers; (2) Operation of effective private or company carpool, vanpool, bus, or similar transportation programs; (3) Evidence that a proportion of residents, employees, and/or customers utilize, on a regular basis, bicycle transportation commensurate with reduced parking requirements."

(Source: Municipal Code Title 18. Zoning Chapter 18.83 Off Street Parking and Loading Regulations Section 18.83.120 www.smartcommunities.ncat.org/codes/paloalto3.shtml.)

In addition, the city allows permeable paving under the following parameters:

> "City of Palo Alto. Municipal Code. Title 18. Zoning Chapter 18-12 R-1 Single-Family Residence District Regulations Section 18.12.050 Site Development Regulations The following site development regulations shall apply in the R-1 single-family residence district. Modifications of some regulations may be applicable if the R-1 single-family residence district is combined with the special building site combining district. More restrictive regulations may be recommended by the architectural review board and approved by the director of planning and community environment, pursuant to Chapter 16.48: (r) Parking and driveway surfaces may have either permeable or impermeable paving. Gravel and similar loose materials shall not be used for driveway or parking surfaces within ten feet of the public right of way."

PROGRAM ADMINISTRATION

Stormwater management or water quality ordinances must also lay out the key elements of program administration. These include, but are not limited to, BMP operation, inspection, maintenance; enforcement; BMP design; methods for evaluating compliance with performance standards; administrative fees; etc. While detailed requirements for these elements are specified in administrative manuals which are referenced in the ordinance (e.g., BMP Design Manual), the ordinance must address program administration in order to provide enabling authority for staff and clarify overall program requirements. Below we have highlighted some of the key requirements for an effective stormwater ordinance as it relates to program administration.

BMP Operations, Inspection Maintenance and Local Enforcement

Regarding regular operations, inspections, and maintenance of BMPs, the first question that a local government needs to answer is, "Who will be required to carry out these duties?" Most local governments

have stipulated that property owners are required to carry out inspections/maintenance and ensure that the BMP is operating properly.

Concerned about whether residential homeowners and homeowners' associations will actually be able to conduct inspections and maintenance over the long-term, the City of Charlotte/Mecklenburg County has said that it will accept maintenance responsibilities from single family detached residential developments and town homes if the BMPs have been satisfactorily maintained during the two-year warranty period by the owner or designee; meet all requirements of the stormwater management ordinance and Design Manual; and include adequate and perpetual access for inspections, maintenance, repair, or reconstruction. For other residential and non-residential developments, the property owner will be required to operate and maintain the BMP facilities. The logic behind this public-private division of labor is that the commercial establishments with professional property managers are capable of carrying out inspections and maintenance duties. More and more jurisdictions with stormwater utilities are questioning whether in the future the utility should assume operations and maintenance of the stormwater BMPs and charge a stormwater utility fee to recoup the cost.

What is required of property owners when they are in charge of maintenance? Progressive ordinances require the following:

Operations and Maintenance Agreement. This legal instrument requires the property owner and its successors, heirs, and assigns to regularly inspect, maintain, and repair stormwater facilities; provides a timeframe for performing needed repairs after inspections; attaches a schedule of long-term maintenance activities to be performed; allows the local government rights of ingress and egress for inspections and monitoring; outlines the requirements for notice of violation; allows the local government to perform needed maintenance if the property owner fails to do so, and requires the property owner to reimburse the local government for all costs incurred. The inspections and maintenance requirements of the agreement depend on the BMPs onsite, but inspections are required at least annually. (Note: Such requirements are also usually outlined in the local government's Construction or Design Manual.)

Annual Inspections and Maintenance Report. This must be submitted to the jurisdiction from a qualified engineer or landscape architect.

Access Easement for Inspections of BMPs. This is a separate legal instrument which is recorded with the deed.

Performance Security for Installation and Maintenance. The local government may require submittal of a performance security or bond with surety, cash escrow, letter of credit, or other legal arrangement prior to issuance of a stormwater management permit. Typically, the local government requires such performance security for the period of BMP installation and a minimum performance bond to cover maintenance or replacement costs after construction has been completed for a certain period of time (e.g., 5 or 10 years). Durham County North Carolina requires that stormwater management permit holders maintain an approved plan and performance security for the life of the project.

What is required of the local government? Through the ordinance, the local government provides enabling authority for local staff (or the jurisdiction's designee) to carry out an inspections program including routine inspections, random inspections, and inspections based on complaints. These inspections may include reviewing maintenance and repair records; sampling discharges, surface water, water in BMPs, etc.; and evaluating the condition of the BMPs. The purpose of the inspection is to determine if the activity onsite is being conducted in accordance with the ordinance and design manual and whether the measures required in the stormwater management plan of the site are effective.

The Ordinance must also specify the consequences of noncompliance, including notice of violation, penalties (e.g., civil penalty), and remedies (e.g., withholding or disapproval of subsequent permits or certificates, injunctions, costs as lien, restoration of areas affected by failure to comply).

Design Manual for BMPs

An effective BMP design manual is a critical feature of a progressive stormwater ordinance. It is more than a set of instructions for constructing a practice to meet a regulation – it must bridge the gaps between the concepts of LID, the goals of the local stormwater management program, and the way the management practices are to be constructed. The manual should communicate the importance of the stormwater management goals, and provide education and detailed guidance to those that use it. Engineers may be accustomed to a cookie-cutter approach to design, and may not understand the reasons for a different approach, nor be familiar with LID goals of retaining stormwater onsite versus the standard approach of moving it off as quickly as possible. With these goals in mind, this section will discuss the following elements:

- How should the BMP design manual be linked to the ordinance?
- What are the important elements of the manual? What should it contain?
- What incentives can be used to encourage the use of innovative practices?

How should the BMP design manual be linked to the ordinance?

The BMP design manual and any other technical documents should be linked to the ordinance by reference. For example, the Town of Huntersville's Water Quality Ordinance says, "Specific requirements regarding the design, installation and maintenance of LID structures and a discussion of LID site planning is contained in the Huntersville Water Quality Design Manual."

It is critically important that the ordinance **does not** include details about design guidelines that achieve performance standards, nor specific assumptions about BMP performance. Current research may indicate that a particular practice achieves a certain level of pollutant removal, or that retention of a particular storm event runoff volume will prevent downstream channel erosion. However, the science of stormwater management is young and rapidly evolving. Current BMP designs may need to be updated. New research may show that a particular BMP does not remove as much of a pollutant as previously thought. Performance standards themselves may need to be changed, if over time they are not working as expected. For this reason, it is more important for the ordinance to refer to the goals of the performance standards (e.g., reduce nutrient runoff from development to protect downstream water resources, reduce impacts of stormwater volume to prevent stream channel erosion and protect biological resources). Separate documents can then be updated as needed to support the ultimate goals. If a specific design is cited in the ordinance as meeting performance standards, it will be much more difficult to change the ordinance itself.

What are the important elements of the manual? What should it contain?

BMP design manuals are quite common, and have typically grown out of a history of engineering requirements for stormwater management. Some are limited in nature. The most basic focus on design elements for peak flow control, and provide little or no context for their purpose. In locations where pollutant impacts from stormwater became an issue, practitioners began developing a larger toolbox of practices, and provided more robust design manuals with background and guidance. North Carolina's BMP manual published in 1999 (NCDENR, 1999) was produced to support recently enacted water supply watershed regulations, which required removal of 85 percent of post-construction sediment loads. The 1999 manual is 85 pages in length, covers eight separate BMPs (including bioretention areas, stormwater wetlands, and infiltration devices), and has detailed narrative about the practices, design calculations with examples, costs, and maintenance. Interest in innovative stormwater management has grown in NC, and the scope of regulation increased when a large portion of the state came under nutrient management regulations resulting from nitrogen TMDLs for large river basins. As a result, the 2007 manual (NCDENR, 2007) has grown to several hundred pages in length, covers 13 practices (including the addition of permeable pavement, green roofs, cisterns, and restored forest buffers), and has an in-depth

discussion of BMP design considerations. While the NC design manual does not promote LID per se, it does show the importance of providing a large toolbox of practices, and educating practitioners about their importance.

An LID stormwater manual should therefore provide the entire holistic framework, starting with a detailed discussion of LID, its goals, and how it represents a fundamentally different way of managing site hydrology. Performance standards specific to the managing authority should also be covered, including why they are needed and how they protect the intended resources. Finally, detailed design guidelines and examples should be provided for each BMP.

For example, Prince George's County (MD) provides two guidance documents, one with an overview of the approach (Prince George's County, 1999a) and one with details about hydrologic analysis (Prince George's County, 1999b). While it the guidance documents are not linked to any specific performance standards, they do discuss in detail the goal of mimicking pre-development site hydrology. The State of Georgia's stormwater management manual includes both a policy/overview document and a detailed design manual (Atlanta Regional Commission, 2001). The design manual provides details about the management goals, including performance standards related to storm event runoff volume, and design guidelines, specifications, and performance standard calculations for 19 BMPs.

What incentives can be used to encourage the use of innovative practices?

One of the fundamental principles of LID is to micromanage runoff and to prevent it from leaving the site. A site that uses a full suite of LID practices should have a greatly reduced volume of runoff, even during a large storm event. Performance standards often require storage and treatment of a significant volume of runoff. By receiving credit for using LID practices, developers can reduce the cost of other practices by reducing their size.

Knox County (TN) has a draft stormwater manual with good examples of how stormwater credits can be used to provide incentives for LID practices. The County's new ordinance (adopted September 2007) includes a performance standard of capturing and treating the runoff from the first 1.1 inches of rainfall, called the Water Quality Volume (WQv). The manual allows for a reduction of the WQv via six practices:

1. Natural area preservation
2. Managed area preservation (open space)
3. Routing runoff to stream and vegetated buffers
4. Using specially designed grass swales for treatment
5. Disconnection of impervious surfaces
6. Large lot neighborhoods

Each has very specific design guidelines and limitations, but used separately or together they may potentially reduce the volume of runoff that must be treated with structural practices, thus reducing the cost to the developer. The last option incorporates low housing densities requirements with other practices, and allows the developer to completely waive the WQv requirement.

Methods for Evaluating Performance Standards and Water Quality Objectives

Assessing performance standards adds a layer of complexity to the process of development review, both for the developer and the regulator. If the calculation of the site targets and how the site meets those practices is complicated, developers may find it difficult to test a variety of innovative designs, and may elect to choose a conventional design. Likewise, the reviewing authority must spend additional time reviewing the calculations and assumptions submitted by the developer for errors.

In some cases, simple calculations or spreadsheet tools may be sufficient. For instance, sediment loads could be estimated from proportions of the site under various land covers (i.e., forest, developed pervious, and impervious) using predetermined factors. A BMP or a set of BMPs treat a portion of the land covers, and the sediment they remove should be calculated using predetermined removal rates. From that, the final sediment load can be estimated.

However, when there are multiple performance standards, this can become difficult. Simple performance standard models can be used to reduce both administrative burden, and to allow the developer to explore a wider range of options. These models do not have to be complicated to learn or use. For example, the City of Huntersville uses the SET, a Microsoft Excel based spreadsheet that was developed to assess the impacts of development, including sediment and nutrient loading, on a site scale. It provides a better environment for testing multiple management practices and site configurations than do simple export calculations, and it incorporates several principles of hydraulic and water quality modeling for more realistic BMP response solutions. The tool lets the user define pre- and post-treated land use/land cover, allowing for multiple drainage areas and various combinations of practices. An important benefit of SET is that the user can test management practices in combination with each other, of a site or small catchment. In addition, both structural and nonstructural practices can be represented, offering a suite of options for evaluation. The Huntersville version of the SET calculates loads and removal for sediment, nutrients, and fecal coliform bacteria, as well as calculating a runoff volume performance standard linked to the location of the development. Other versions of the SET also calculate storm event peak flow. The SET also estimates pre- and post-development annual runoff, an important measure for LID.

LAND USE CODES ALLOWING EFFECTIVE SITE DESIGN

A strong stormwater ordinance is only half of the equation for effective stormwater management. A local government also needs to have a development ordinance that allows or even encourages effective site design for reducing or managing stormwater. While strong stormwater performance standards can provide an impetus for developers to minimize impervious area, maximize undisturbed area, and other good site design techniques, often local codes erect barriers and disincentives to implementing LID.

Local governments and developers practicing LID design over the last decade have developed some tools and methods for doing so. They have provided useful guidelines for low-impact site design, which include the following steps (Prince George's County, 1999a):

1. Identify applicable zoning, land use, subdivision, and other local regulations.
2. Define development envelope and protected areas (reduce limits of clearing and grading; use site fingerprinting).
3. Use drainage/hydrology as a design element.
4. Reduce/minimize total impervious area.
5. Develop integrated preliminary site plan.
6. Minimize directly connected impervious areas.
7. Modify/increase drainage flow paths.
8. Compare pre- and post-development hydrology (using hydrologic analysis).
9. Complete site plan.

Based on local governments' experience, USEPA, the Center for Watershed Protection, and others have developed a number of "how to" LID design documents. In taking the first step toward LID, i.e., identifying applicable zoning and land use regulations, the Center for Watershed Protection has developed *Better Site Design: A Handbook for Changing Development Rules in Your Community* (1998). The Guide

includes a Code and Ordinance Worksheet, which is a tool for reviewing the standards, ordinances, and codes that shape how development occurs in a community and how the local rules compare to the principles of better site design. In addition, the USEPA has produced a series of documents on LID. The first in the series is *Low-Impact Development Design Strategies, An Integrated Approach* (1999). This and other LID manuals are at: http://www.epa.gov/owow/nps/urban.html.

The Smart Growth Leadership Institute has conducted code audits for larger scale code and land development standards. These codes are based on concepts related to smart growth and comprehensive planning. To see their worksheet, go to http://www.epa.gov/smartgrowth/scorecards/sglicodeaudit.pdf. Also, the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) developed an audit procedure for code language for its 17 member cities, the Santa Clara Water District, and the County. Visit the "Summary of Findings" link at http://www.scvurppp-w2k.com/compare_contrast.htm (the worksheet begins on page II.14).

Tetra Tech recommends making the ordinance revisions highlighted above, either through a holistic "roundtable process" described in the *Better Site Design Handbook*, or incrementally through text amendments. However, as noted in conversations with staff of many local governments, many LID elements are currently allowed in the local ordinances, but are not encouraged and in some cases discouraged. Therefore, Tetra Tech recommends that each jurisdiction work interdepartmentally—with the Planning, Engineering and Public Works Departments—to resolve issues and remove barriers which are blocking use of the above LID practices.

Below is a checklist, Opportunities for Low-Impact Development Design Techniques, that can be used in the local ordinance review and roundtable discussion process. This checklist is adapted from *Low-Impact Development Design Strategies*, Prince George's County MD; *Better Site Design: A Handbook for Changing Development Rules in Your Community*, Center for Watershed Protection; and *State of North Carolina Model Ordinance for Water Supply Watershed Protection*. In reviewing summaries of roundtable discussions and recommendations for better site design, these are the types of issues that need to be addressed in local ordinances to remove barriers to LID.

Checklist: Opportunities for Low-Impact Development Design Techniques

Clearing and Grading

- Is disturbance of vegetated areas and riparian areas minimized?
- Do the building envelopes avoid sensitive environmental areas such as riparian areas, wetlands, high infiltration soils, steep slopes, etc.?
- Is total site disturbance minimized?

Minimizing Impervious or Built Upon Area

Streets

- For low volume residential roads and streets, are the street pavement widths between 18 to 22 feet?
- Do regulations promote or allow the most efficient street layout to reduce overall street length? This may include revising frontage requirements.
- Can the culs-de-sac radius be 35 feet or less?
- Are landscaped island or bioretention islands allowed or encouraged in culs de sac?
- Are grass swales or bioretention swales used instead of curb and gutter where slopes allow?

Parking/Driveways/Sidewalks

- For office buildings, is the parking ratio 3.0 spaces per 1000 sq.ft. of gross floor area or less?
- For commercial centers, is the parking ratio 2 to 4.5 spaces per 1,000 sq.ft. of gross floor area or less?
- Is a mass transit stop provided or nearby (if applicable)?
- Can a proposed development take advantage of opportunities for shared parking?
- Is the minimum stall width for a standard parking space 9 feet or less?
- Can parking medians (if required) have bioretention cells where feasible?
- Are driveways 9 feet or less in width?
- Are shared driveways used?
- Is on-street parking considered and imperviousness minimized (no on-street or single-side parking where allowed)?
- Are sidewalks (if required) designed to the narrowest allowable width?
- Can developments provide sidewalks on one side of street only?

Clustering Development

- To encourage clustering and open space design, are setbacks minimized (e.g., for residential lots that are ½ acre or less in size is the front setback 20 feet or less, the rear setback 25 feet or less, and the side setback 8 feet or less)?
- Does the design focus development on areas of lesser slopes and farther from watercourses?

Preserving Sensitive Areas

Wetlands

- Are existing wetlands preserved?
- Will the site design minimize hydrologic alteration to existing wetlands?

Steep Slopes

- Does the ordinance encourage or require that building footprints be concentrated on slopes 10 percent or less?
- Is disturbance minimized on slopes 15 percent to 25 percent and revegetation proposed where disturbance occurs?
- Does the ordinance promote preservation of areas with 25 percent or greater slope?

Soils

- Do the building footprints avoid highly erodible soils?
- Do the building footprints avoid soils with high permeability?

Stream Buffer

- Does the ordinance encourage or require that a 50 to 75 foot stream buffer be provided?
- Will the stream buffer remain in a natural state?

Managing Open Space

- Does the ordinance promote or require open space preservation?
- Will the preserved open space be managed in a natural condition?
- Will there be a Homeowners Association or other association that can effectively manage the open space?

After reviewing the summary of roundtable discussions and recommendations from a number of communities, it appears that some of the most challenging issues to reach consensus on include:

- *Residential street and roads widths*. The recommendation for 18 to 22 feet streets widths (for low volume traffic) often conflicts with state minimum road and street design requirements, which are in turn adopted and required by local governments before accepting a street for public maintenance. Fire departments also object to the narrower streets because they believe they are not wide enough for fire trucks to navigate.
- *Culs-de-sac.* The recommendation that a cul-de-sac have a radius of 35 feet or less can conflict with state DOT standards. For example PennDOT requires use of a circular turn around with a 40-foot minimum radius in order for municipalities to receive state funding. This standard is related to transport of liquid fuels.
- *Use of grass swales and bioretention areas rather than curb and gutter.* The major objection to this recommendation comes from local engineering and public works departments that are concerned about the maintenance of the swales and street edges and the use of swales on steeply sloped areas.
- *Use of one sidewalk rather than two.* Planning departments often object to this ordinance revision because they believe it conflicts with their goal of providing walkable communities.
- *Reducing residential setback and frontage requirements to encourage cluster development*. Planning Departments are concerned that the reduced setback/frontage requirements would be incompatible with exiting neighborhoods built under traditional subdivision requirements.

Clearly, in many cases, state DOT standards will need to be addressed in order for local governments to eliminate barriers in their ordinances related to street design. In most cases, the resistance to ordinances changes arises from competing local government departmental objectives and concerns. The planning, public works, and fire departments have to resolve these internal issues to determine the extent to which LID techniques can be incorporated into the subdivision and zoning ordinances and used in the community. For each issue, it will be important to show how other communities have overcome barriers through creative design, construction standards, approval process requirements, etc.

Appendix D: LID Grant Solicitation Draft Language and Evaluation Criteria

PURPOSE

This section includes language that could be used in a grant solicitation or request for proposals (RFP) to encourage implementation of LID at the local level. Two types of projects are envisioned: planning projects for municipalities to audit and update codes and ordinances that allow or encourage LID, and implementation projects in which communities would install LID features as part of capital improvements. Included in this grant solicitation language is a checklist for communities to quantify the extent to which codes and ordinances allow, encourage, or require LID and related measures. This checklist and other details of the grant solicitation language are intended to divide the grant applicants into categories based on progress achieved thus far. Ultimately, this solicitation language would reward communities that have already audited and updated codes and ordinances, while still providing an opportunity for financial support to communities who would like to implement code and ordinance changes but may not have had the impetus or resources in the past. Note that additional details, such as criteria and a ranking system to evaluate proposed implementation projects, would need to be included before a solicitation of this type is issued.

APPLICABLE PROJECTS

Grants under this type of solicitation would be for two types of projects: (1) planning projects that will bring about changes in codes and development of LID performance standards, and (2) implementation projects, namely capital improvement projects that have one or more LID components.

Planning Projects

These projects will involve performing a detailed audit (see Appendix A) of all zoning and development-related codes to identify conflicts with LID principles, or conducting studies to establish at the local level where barriers or long-standing practices have been identified and prevent adoption of LID (e.g., a parking utilization study). The result will be to revise code language and develop stormwater performance standards for new and redevelopment projects. Additional planning projects can include development of a performance standard for LID techniques or development of an active monitoring program for LID practices.

Implementation Projects

These projects will require that one or more LID practices be incorporated into a capital improvement project. Alternatively, the project may involve the retrofit of an existing municipal property with one or more LID practices. Examples of LID practices include porous pavement, ecoroofs, bioretention, downspout disconnection, conversion of impervious surfaces to pervious surfaces, regrading and amending soils for enhanced stormwater capture, and other integrated stormwater management techniques.

EVALUATION CRITERIA

To be evaluated for an award, applicants are required to perform a self-audit of local codes and standards using the checklist included in Appendix A. For each affirmative answer, applicants should provide a citation for the applicable development code or standard (page, section, or line number).

Eligibility

Applicants will be eligible for grant funding for planning or implementation projects based on the self-audit responses as follows:

Score of 0 to 10 points:

Applicants that score between 0 and 10 points on the self-audit are not eligible for implementation project grants. However, they are eligible for a grant to revise codes/ordinances and develop guidelines to increase their self-audit score to 15.

Score of 11 to 24 points:

Applicants that score between 11 and 24 points are eligible for implementation project grants with the condition that they revise codes/ordinances and develop guidelines to increase their self-audit score to 25.

Score of 25 or more points:

Applicants who score 25 or more points on the self-audit are eligible for an LID implementation project grant without conditions.

For planning assistance, applicants must submit a letter of good faith from the planning director or other municipal executive stating that they support code revision and standards development as proposed in the grant application.

Project Merit

Grant applications will be assessed based on project merit. In your grant application, please describe the following for each type of project:

Planning Projects:

Describe proposed changes to codes and standards to improve the self-audit score to the required minimum. List code/standard language that is in conflict with LID and discuss possible changes to remove conflicts. Describe studies that might be needed to obtain stakeholder buy-in, such as parking utilization studies or demonstration projects with emergency responders. Describe the administrative process to implement changes, including the process through which stakeholders (other municipal departments, citizen groups, developers, etc.) will be involved.

Implementation Projects:

Describe the capital improvement project and identify the LID component(s) to be incorporated. Identify the waterbody or waterbodies affected by stormwater runoff from the site and discuss how the LID features will address recognized pollutants of concern for the waterbody or waterbodies. Estimate reductions in directly connected impervious surfaces that result from LID practice implementation. Describe how the LID project fits into the larger watershed management system. Outline a plan to assess the performance of the project over the long term, and identify whether monitoring will be performed as part of this assessment. Describe how maintenance of the LID project will be assured over the long term.

Applicants proposing planning and implementation projects must submit descriptions for both project types as described above.

LOW IMPACT DEVELOPMENT CODE AND ORDINANCE SELF-AUDIT

To be evaluated for an award, applicants are required to perform a self-audit of local codes and standards using the following checklist. For each affirmative answer, applicants should provide a citation for the applicable development code or standard (page, section, or line number). Applicants will be eligible for grant funding for planning or implementation projects based on the self-audit responses as follows:

Score of 0 to 10 points:	**Score of 11to 24 points:**	**Score of 25 or more points:**
Applicants can apply for a grant to revise codes/ordinances and develop guidelines to increase the score to a minimum of 15.	Applicants can apply for a grant to revise codes/ordinances to increase the score to a minimum of 25 and propose an LID implementation project.	Applicants can apply for a grant for an LID implementation project.

A. GENERAL INFORMATION

Name of Applicant: _____

List Citations for Codes/Ordinances Relevant to Stormwater and Smart Growth: _____

_____

_____

_____

B. STORMWATER ORDINANCE

How have post-construction stormwater requirements been incorporated into local ordinances?

- ☐ A stand-alone post-construction stormwater ordinance has been developed (2 points)
- ☐ Post-construction stormwater requirements have been integrated into a development ordinance or another type of ordinance (2 points)
- ☐ Post-construction stormwater requirements were included in several different ordinances (2 points)

Attach copies of the official approval (e.g., letter, meeting minutes) showing adoption of the ordinance(s) by the municipal governing body.

- ☐ Post-construction stormwater requirements are not yet included in local ordinances (0 points)

C. General Plans

How has post-construction stormwater management, natural drainage, or low impact development been incorporated into your General Plan?

- ☐ The General Plan has been reviewed and General Plan Elements have been amended to include natural drainage, low impact development, and post-construction stormwater management (2 points)
- ☐ The City/County is in the process of identifying where natural drainage, low impact development, and post-construction stormwater management should be included in the next update of the General Plan (1 point) Date of next General Plan update: _____
- ☐ The City/County has not yet initiated a review of the General Plan for inclusion of natural drainage, low impact development, and post-construction stormwater management (0 points)

D. Code Language

Please review the list of stormwater- and smart growth-related code language and check all that are included in existing codes or ordinances. If a change has been implemented already, provide a section, page, or line reference for the code change. Note this may include zoning codes, specific plans or standards issued by Transportation and Fire Protection Districts.

The items below are scored at 1 point each.

Clearing and Grading

- ☐ Do codes/ordinances regulate the disturbance of vegetated areas and riparian areas? Indicate the extent to which disturbance is limited: _____ (Reference: _____)
- ☐ Do codes/ordinances regulate the total amount of site disturbance? Indicate the extent to which disturbance is limited: _____ (Reference: _____)

Minimizing Impacts of Impervious or Built Area

Streets

- ☐ For low-volume residential roads and streets, are the street pavement widths required to be between 18 and 22 feet? (Reference: _____)
- ☐ Do codes/ordinances promote or allow the most efficient street layout to reduce overall street length? This may include revising frontage requirements. (Reference: _____)
- ☐ Do codes/ordinances allow a cul-de-sac radius to be 35 feet or less? (Reference: _____)
- ☐ Are landscaped islands or bioretention islands allowed or encouraged in culs-de-sac? (Reference: _____)
- ☐ Are LID techniques (e.g., grass swales, bioretention swales, tree planters, etc.) allowed, encouraged, or required to be used instead of curb and gutter where slopes allow? (Reference: _____)

Parking/Driveways

- ☐ Has a parking utilization study been performed and were results incorporated into codes/ordinances? (Reference: _____)
- ☐ Do codes/ordinances provide incentives for shared parking? (Reference: _____)
- ☐ Is the minimum stall width for a standard parking space allowed, encouraged, or required to be 9 feet or less? (Reference: _____)
- ☐ Can parking medians (if required) have bioretention cells where feasible? (Reference: _____)
- ☐ Is porous pavement allowed, encouraged, or required? (Reference: _____)
- ☐ Are driveways allowed, encouraged, or required to be 9 feet or less in width? (Reference: _____)
- ☐ Are shared driveways allowed, encouraged, or required? (Reference: _____)
- ☐ Is imperviousness associated with on-street parking required to be minimized (e.g., no on-street parking, or single-side parking where allowed)? (Reference: _____)

Buildings/Landscape

- ☐ Are green roofs allowed, encouraged, or required? (Reference: _____)
- ☐ Is roof runoff allowed, encouraged, or required to be directed to bioretention planter boxes, bioswales, bioretention cells, or other landscaped/pervious area? (Reference: _____)
- ☐ Are cisterns, rain barrels, or other methods for water reuse allowed, encouraged, or required? (Reference: _____)
- ☐ Has the master landscaping code been revised (or have revisions been initiated) to integrate water conservation, water reuse, and stormwater handling within landscaped areas? (Reference: _____)

Preserving Sensitive Areas

Wetlands/Floodplains

- ☐ Do codes/ordinances require prevention or mitigation of hydrologic impacts on existing wetlands and floodplains? (Reference: _____)
- ☐ Are site designs required to mitigate the impacts of hydrologic alteration to existing wetlands/floodplains by including such areas in stormwater management calculations? (Reference: _____)

Steep Slopes

- ☐ Do codes/ordinances encourage or require that building footprints be concentrated on slopes 10 percent or less? (Reference: _____)
- ☐ Do codes/ordinances require that disturbance be minimized on slopes 15 percent to 25 percent and revegetation proposed where disturbance occurs? (Reference: _____)
- ☐ Do codes/ordinances require preservation of areas with 25 percent or greater slope? (Reference: _____)

Soils

- ☐ Are building footprints required to avoid highly erodible soils? (Reference: _____)
- ☐ Are building footprints required to avoid soils with high permeability (e.g., Soil Conservation Service Soil Group A)? (Reference: _____)

Stream Buffers

- ☐ Do codes/ordinances encourage or require a scientifically defensible wetland/riparian buffer setback? (Reference: _____)
- ☐ Do codes/ordinances limit activities (e.g., material storage, mowing, etc.) in wetland/riparian buffer zones? (Reference: _____)

Managing Open Space

- ☐ Have local park and open space plans been revised to incorporate stormwater management features into pervious and landscaped areas? (Reference: _____)
- ☐ Have codes/ordinances governing open space for multi-family residential development been revised to include on-site water quality and quantity management of stormwater? (Reference: _____)
- ☐ Do codes/ordinances encourage or require open space preservation based on a regional or watershed-scale plan? (Reference: _____)
- ☐ To encourage clustering and open space design, are setbacks allowed, encouraged, or required to be minimized? (Reference: _____)
- ☐ Do codes/ordinances encourage or require that development be directed to already-developed areas (e.g., infill sites or corridor redevelopment areas)? (Reference: _____)

E. SCORING AND PROJECT CATEGORY

Applicants will be eligible for grant funding for planning or implementation projects as follows:

Score of 0 to 10 points:	**Score of 11to 24 points:**	**Score of 25 or more points:**
Applicants can apply for a grant to revise codes/ordinances and develop guidelines to increase the score to a minimum of 15.	Applicants can apply for a grant to revise codes/ordinances to increase the score to a minimum of 25 and propose an LID implementation project.	Applicants can apply for a grant for an LID implementation project.

Total Number of Points: _____

Please Mark the Appropriate Project Category:

☐ Planning (0-10 pts) ☐ Planning/Implementation (11-24 pts) ☐ Implementation (>25 pts)