Linda S. Adams
Agency Secretary

California Regional Water Quality Control Board

Central Coast Region

Arnold Schwarzenegger
Governor

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July 17, 2008

Christopher Callihan, Deputy City Attorney
City of Salinas
200 Lincoln Ave.
Salinas, CA 93901-2639

Dear Mr. Callihan;

REQUIRED REVISIONS TO SALINAS STORMWATER DEVELOPMENT STANDARDS

This letter is a follow up to Matt Thompson's June 12, 2008 email, in which he requested you begin revising the May 2008 Revised Salinas Development Standards (Standards) to address comments by the Low Impact Development Center of Maryland. After further review of the Standards by Water Board staff and Water Board members during the public meeting on July 11, 2008, I request you revise the Standards before I recommend Water Board approval. These revisions are necessary for staff to determine that the Standards comply with the Phase I Storm Water Permit for the City of Salinas and meet the maximum extent practicable standard; this will achieve our goal of protecting healthy watersheds. Water Board staff explained our need for these revisions in detail with Carl Niizawa and your consultants after the Water Board meeting on July 11, 2008. In summary, the Standards must be revised to address the following comments:

1. Resolve all comments in the Low Impact Development Center of Maryland's June 10, 2008 memo (attached). All comments labeled *Important to Address* must be included in the revised document. Should you decide not to include certain revisions, you must provide technical justification in a response to this letter (see Request for Response below).

2. The General Performance Criteria for Stormwater Management in Section 1.5.1 must be revised to be measurable and enforceable. This is my second request for this revision to the Standards. I indicated this revision was necessary based on review of the Draft Standards in a letter sent to you on April 2, 2008. Matt Thompson and Lisa McCann met with you and Carl Niizawa on April 16, 2008 to review and discuss this and other revisions in more detail. As currently written, most of these criteria are written in a narrative form (e.g., "Minimize the rate, volume, and pollutant loading of stormwater runoff..."). Such narrative language is subject to open interpretation and is not usable for regulatory and design purposes. The General Performance Criteria must include numeric standards wherever feasible, especially for the typical measures of hydromodification such as time of concentration, drainage density, and runoff hydrographs. I've attached a letter dated July 10, 2008, that I've sent to all communities subject to Phase II stormwater regulations, which should guide you in this regard.

3. The Standards must clearly require a study defining pre-development hydrology, per Attachment 4 of your NPDES permit. Low impact development involves planning and

designing development to mimic pre-development hydrology. Proper implementation of LID is not possible without defining pre-development hydrology.

Request for Response. I request you submit the revised Standards for my consideration and public comment by no later than **July 25, 2008**. In order to facilitate staff review, I request you submit a written response to this letter with the Standards that indicates precisely where in the Standards each revision is made (e.g., section and page number). If for technical reasons you decide not to incorporate a particular required revision, I request you provide your technical justification for not making the required revision.

I appreciate your prompt attention to this request and I look forward to reviewing the revised Standards. If you have questions, please contact **Matt Thompson at (805) 549-3159** or Lisa McCann at (805) 549-3132.

Sincerely,

Roger W. Briggs
Executive Officer

Attachments:
1. LID Center comments dated June 10, 2008
2. July 10, 2008 letter to Phase II MS4s

cc: City of Salinas Staff and Consultants:
Carl Niizawa, 200 Lincoln Ave, Salinas, CA 93901-2639
Dale Rosskamp, 65 W. Alisal St, Suite 101, Salinas, CA 93901-2639
Denise Estrada and Michael Ricker, 426 Work St, Salinas, CA 93901
Chris Conway: ChrisConway@KennedyJenks.com
Harvey Oslick: HOSLICK@rbf.com

NPDES Stakeholder Committee (via email):
Gary Shallcross: gary_shallcross@csumb.edu
Steve Shimek: exec@otterproject.org
Robin Lee: landgaze@hotmail.com
Traci Roberts: traci@montereycfb.com
Ken Tunstall: kenneth@tunstallengineering.com
Dan Matthies: DMatthies@WoodRodgers.com
Sue Shaffer: sshaffer@creekbridge.com
Bob Meyer: meyerb@co.monterey.ca.us

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The Low Impact Development Center, Inc.
4600 Powder Mill Road, Suite 200
Beltsville, Maryland 20705
Telephone: 301.982.5559
Fax: 301.937.3507

M E M O R A N D U M

Date: June 10, 2008

To: Roger Briggs, Executive Officer, Central Coast Water Board

From: Neil Weinstein, Executive Director, The Low Impact Development Center

Re: LIDC# – L-2197

Subject: Review of the *Draft City of Salinas Stormwater Development Standards for New Development and Significant Redevelopment Projects* dated May 2008

The Low Impact Development Center (Center) is a non-profit 501(c)(3) national research organization that focuses on sustainable storm water management solutions for urban and developing areas. The Center's mission includes the design and implementation of pilot projects, monitoring and modeling to determine the effectiveness of practices, development of manuals of practice, and training. The Center has developed national and local LID technical manuals detailing site design, construction, and maintenance considerations including U.S EPA's *Low Impact Development Training for Western Developers*. In addition, the Center has worked with the State Water Resources Control Board to develop and deliver Low Impact Development (LID) training sessions and prepare a review of LID policies and implementation barriers and opportunities. These technical endeavors are complemented by the Center's contributions to several regulation and policy development efforts intended to encourage LID use.

The Central Coast Water Board posed the following questions to the Center concerning the City of Salinas Stormwater Development Standards for New Development and Significant Redevelopment Projects dated May 2008 (Development Standards):

- Does the document sufficiently require early planning for LID?
- What is missing or incorrect in order for LID practices to be properly designed, constructed, and maintained? Are any of the proposed LID practices unacceptable?
- Are the proposed standards sufficiently prescriptive? If not, which standards must be required? Which standards may be considered guidelines?
- Do the standards provide reasonable alternatives if infiltration is not feasible at a particular site (e.g., due to high clay soils)?
- Is the proposed waiver criteria appropriate?
- How could the document be more user-friendly?

The Center's responses to these questions can be found below. The responses are divided into two categories; comments the Center believes should be addressed before the adoption of the Development Standards, and comments that are advisory, things the Center suggests considering.

The Center's review focused on whether the Development Standards would result in the effective implementation of Low Impact Development in Salinas. The Center concluded that if the matters labeled as *Important to Address* are resolved, the document provides a sufficient start to LID implementation in

Salinas. As the Development Standards are implemented, input and feedback should be solicited from the users to gauge how well the document serves its intended purpose and target audience.

QUESTION 1: Does the document sufficiently require early planning for LID?

Important to Address:
The document requires a pre-application meeting with the City for the purpose of discussing "a strategy for implementing LID planning practices into a conceptual site design" (Section 1.9, titled "Development Review Process," page 1-16). Section 1.9.1, titled "Project Conceptualization and Development," lists on page 1-19 the elements that the applicant must incorporate into the proposed project concept. Other places in the document also list site planning techniques or strategies, however, each of the lists is slightly different. For example, Section 1.5.2, titled "Site Design Planning," states that, "Consideration in the planning process shall be given to the following:" and lists minimizing the amount of impervious surface as one of the considerations. This topic is not found in the list on page 1-19. Section 2.1, titled "What is LID?" gives a list of LID strategies and techniques, not all of which are listed on page 1-19, but may need to be considered in the early planning phase such as directing runoff to areas that support infiltration. In addition, Section 2.4, titled "LID Planning Techniques," has four sub-sections which do not cover all of the LID planning techniques mentioned in other sections of the Development Standards.

Early planning for LID is important and the pre-application meetings provide an excellent opportunity for the applicant and the City to work together to create a successful project that meets the applicant's needs and the City's requirements. However, in order for the pre-application meetings to be productive and effective, the applicant needs to know specifically what is required in order to be adequately prepared for the discussion. For example, if the City is interested in discussing minimization of impervious surfaces at the pre-application meeting, this should be added to the list on page 1-19 so that the applicant is ready to discuss the topic at the meeting.

QUESTION 2: What is missing or incorrect in order for LID practices to be properly designed, constructed, and maintained? Are any of the proposed LID practices unacceptable?

Important to Address:
Sections 4 and 5 of the Development Standards do not address the analysis of an entire site with distributed LID BMPs. Guidelines are given on how to design individual LID BMPs given its micro-watershed, but there is no mention of how a distributed BMP network will work to achieve stormwater management goals or requirements. This task is complex, but can be done with various stormwater modeling programs, like EPA Storm Water Management Model (SWMM) and Bay Area Hydrology Model. This is an area of LID site design that is still developing and jurisdictions have taken different approaches. Regionally, the Bay Area Hydrology Model (based on the Western Washington Hydrology Model) is being used to develop hydromodification plan requirements in the southern San Francisco Bay Area counties.

The Development Standards suggest using the rational method for sites of 25 acres or less. Using the rational method for a site with distributed BMPs will not fully account for the peak reduction from LID practices. Assigning a C value to an LID practice (Table 4-4: Runoff Coefficients (C Factor) for BMP Design, page 4-23), is inappropriate. Depending on design, it is possible for an LID practice to have little to no runoff for large events. If LID is used for credit toward peak reduction and a reduced detention requirement, then a computer routing simulation should be used. The EPA SWMM is capable of modeling most LID BMPs and can simulate flow routing. While it may be unreasonable to demand

computer modeling of small development sites, 25 acres is too large for a simplified rational method approach. These projects are large enough that a more sophisticated model is justified.

Other considerations:
The term swale is not used in Section 5. Swales should be encouraged. Well designed swales can be safe, attractive, reduce flow volumes, and improve water quality. Swales are not included in the Manning's number chart, CASQA assigns swales a Manning's number of 0.25.

QUESTION 3: Are the proposed standards sufficiently prescriptive? If not, which standards must be required? Which standards may be considered guidelines?

Important to Address:
Section 5.4 of the Development Standards states, "Conservative assumptions shall be made regarding the effectiveness of LID techniques, such as lowest realistic long-term infiltration rates and highest reasonable initial water levels in storage areas, for the purpose of calculating discharges for drainage facility design." More specific design criteria are needed. Are the minimum infiltration rates given in Table 5-3, titled "Infiltration Rates from City's Stormwater Master Plan," to be considered the lowest realistic long-term infiltration rate? A drawdown time between storm events might be adequate for estimating the highest reasonable initial water levels. Table 4-3, titled "City of Salinas Stormwater Infiltration System Design Standards," suggests LID BMPs be designed to be free of surface water within a maximum of 72 hours. The standard should be the same as the standard for detention basins. Are detention basins assumed to be empty at the start of a design storm event?

Other Considerations:
Besides sufficiently prescriptive standards in this document, other codes and ordinances are needed to prevent the implementation of LID from being hindered. Documents such as the City's Master Plan, Zoning Restrictions, Recreation Codes, Land Use Regulations and Plumbing Codes (in the case of cistern use) should be reviewed and amended if necessary to ensure consistency with the Development Standards.

QUESTION 4: Do the standards provide reasonable alternatives if infiltration is not feasible at a particular site (e.g. due to high clay soils)?

The Development Standards specify the use of lined LID practices with underdrain systems in areas with poorly draining soils. This design will attenuate peak flows, provide water quality treatment through filtration, and provide a little volume reduction due to evapotranspiration and evaporation. If the native soils are poorly draining soils, the benefits described match the natural condition. Therefore, the alternatives are reasonable, both on the small scale of individual BMP design and on the large scale of maintaining the natural hydrologic condition.

However, in areas where infiltration is not feasible due to soil conditions or dense urban development, cisterns are used to capture and reuse rain water for non-potable uses such as toilet flushing water or irrigation. This document mentions cisterns only briefly.

QUESTION 5: Is the proposed waiver criteria appropriate?

Important to Address:
Section 1.4.6, titled "Waivers for Providing Storm Water Management," allows the City Engineer the flexibility to issue a waiver if compliance with a particular portion(s) of the Development Standards is determined to be infeasible. Instead of complying with the Development Standard section(s) deemed infeasible, the applicant must pay into a City Stormwater Mitigation Fund, 135% of the estimated construction savings. Section 1.4.6 states that, "the City is currently in the process of developing a Waiver Program for approval by the Regional Board." It lists the things that the approved waiver program will, at a minimum, identify. The list does not include "the criteria the City Engineer will use to determine feasibility of compliance," nor does it include "how the 'estimated construction savings' will be calculated."

The "estimated construction savings" calculation method should be created in such a way that prevents the applicant from inflating actual construction costs so that the "estimated construction savings" is zero, thereby avoiding paying into the City Stormwater Mitigation Fund. Alternatively, the City may consider using criteria for payment into the City Stormwater Mitigation Fund that is based on amount of impervious area or the amount of stormwater discharged rather than cost savings (See Washington, DC's Anacostia River Environmental Standards). There are many case studies that show that implementing LID costs less than traditional development (See *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices,* U.S. EPA, December 2007). Ideally, the method used for calculating the amount of money paid into the City Stormwater Mitigation Fund should focus on mitigation for downstream impacts. In other words, what would it cost for the City to mitigate for the amount of water being discharged from a site not implementing peak flow or water quality controls? The calculation method used should ensure that an applicant from receiving a waiver from compliance adequately compensates the City Stormwater Mitigation Fund for the project's long-term environmental impact.

Other Considerations:
Section 1.4.6 also states that, "the City will notify the Regional Board within one month of each waiver issued and shall include the name of the person granting each waiver." The Central Coast Water Board may also want to require that the reason compliance was deemed infeasible, as well as the applicant's name be included in the notification, at least for the first year, to ensure that the waiver system is working as intended.

QUESTION 6: How could the document be more user-friendly?

Important to Address:
Low Impact Development can be thought of as having three steps; hydrologic analysis, site planning, and BMPs. Hydrologic analysis is used to determine the pre-development hydrologic condition for a given site. Maintaining that pre-development, or natural, hydrologic condition is the goal. Site planning strategies use site features as the first step in achieving the goal. The selection, design, and implementation of LID BMPs adds additional volume reduction/peak reduction/water quality features needed to meet the goal of maintaining the natural hydrologic condition. Section 2.1, titled "What is LID?," does not adequately address how and why site planning, as discussed in previous sections, is a part of LID.

Other Considerations:
The "Plan to Avoid the Three Most Common Mistakes" is a very useful section of the Executive Summary that helps the reader know right away what sorts of things they will need to focus on. However,

the "How to Use This Document" section of the Executive Summary in its narrative form is difficult to read. Putting this content into a flow chart or graphic may relay the same information in a format that is easier to follow and reference as one moves through the process.

Figure 1:3, titled "Project Applicability & Applicant Education," does not appear to be mentioned nor explained in the text unless the reference to Figure 1:2 on page 1-19 is meant to refer to Figure 1:3. There is a box on Figure 1:3 that asks, "Is proposed project required to meet stormwater runoff requirements?" It is unclear what is meant by this question. When would a project not be required to meet stormwater runoff requirements? If it is not a new development or significant redevelopment project as specified in Section 1.4? Or is this question referring to the waiver process?

Section 2.5, titled "Stormwater and LID Concepts," is a useful section that briefly and clearly defines many of the terms used throughout the Development Standards. It may benefit the reader to move this section to a location earlier in the document, such as the end of Section 1.

Throughout the Development Standards document, using call-out boxes or bold font for important standards would help the reader locate important information quickly.

Section 3, titled "LID Designs and Practices," houses the bulk of the BMP resource information. In order to make this section a valuable resource to the reader, the web links should be functioning links to useful information. Some of the links are not active links. Attachment A of this document, titled "Section 3 Review Comments," contains a listing of the broken links and the active link to replace it with. Other suggested edits for Section 3 can be found in Attachment A.

Section 3 (Calculations and BMP Description) and Section 6 (BMP selection description) of Appendix D should be merged. The information requested in these two sections overlap.

Appendix G, titled "LID Planting Zones and Plant List," is meant to be a resource for vegetation selection for LID practices. Attachment B of this document, titled "Appendix G Review Comments," contains suggestions to make Appendix G a more practical resource.

Suggested Edits for Section 3:

I. **Images without credit information**
II. **Tables that need a label**
III. **Equations**
IV. **Broken links**

I. Images without credit information

Figure #	Page #
3-1	3-2
3-5	3-7
3-6	3-8
3-7	3-9
3-14	3-25
3-16	3-26
3-17	3-26
3-29	3-49
3-30	3-49
3-31	3-50
3-32	3-50
3-33	3-51

Bottom of Page 3-93

- Photograph Sources – Does not note which photos they are referring to.

II. Tables that need a label (e.g., Table 3-1. Description., Table 3-2. Description.)

Page #:
3-10, 3-20, 3-21, 3-22, 3-23, 3-24, 3-29, 3-35, 3-41, 3-59, 3-62, 3-67, 3-73, 3-77, 3-80, 3-84, 3-94

III. Equations

- It would be helpful to add label to equations (e.g. Equation 1. —)
- Indent "Where: …"

III. Broken Links

Page 3-5
Broken URL:
http://www.toolbase.org/tertiaryT.asp?TrackID=&DocumentID=2160&CategoryID=38
New URL: http://www.toolbase.org/Technology-Inventory/Sitework/permeable-pavement

Page 3-7
Broken URL:
http://www.psat.wa.gov/Publications/LID_tech_manual05/LID_manual2005.pdf

New URL: http://www.psp.wa.gov/downloads/LID/LID_manual2005.pdf

Page 3-11
Broken URL: http://www.nemo.uconn.edu/publications/tech_papers/tech_paper_9.pdf
New URL: http://www.nemo.uconn.edu/tools/publications/tech_papers/tech_paper_9.pdf

Page 3-12
No URL given for: Site Planning for Urban Stream Protection
URL to add: http://www.cwp.org/SPSP/TOC.htm

Page 3-13
Broken URL: http://www.unce.unr.edu/Westem/SubWebs/NEMO/index.htm
New URL: Found it in this document (Figure 3-47), which looks like it was created by Kennedy/Jenks
http://www.cityofreno.com/Modules/ShowDocument.aspx?documentid=10752

Page 3-14
Broken URL: http://www.unce.unr.edu/Western/SubWebs/NEMO/index.htm
New URL: Unable to find a new link

Page 3-15
Broken URL: www.nemo.uconn.edu/publications/tech_papers/tech_paper_6.pdf
New URL: http://www.nemo.uconn.edu/tools/publications/tech_papers/tech_paper_6.pdf

Page 3-16
Broken URL:
http://www.psat.wa.gov/Publications/LID_tech_manual05/LID_manual2005.pdf
New URL: http://www.psp.wa.gov/downloads/LID/LID_manual2005.pdf

Link associated with image works: http://www.forester.net/sw_0103_porous.html
About URL: I did not find the corresponding picture on that page.

Page 3-18
Hyperlink is incorrect because of text wrapping:
http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.asp
Correct:
http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.asp

Page 3-28 [no URLs given on this page, not critical]
No URL given for: Suppliers of Beneficial Organisms in North America
URL to add: http://www.cdpr.ca.gov/docs/pestmgt/ipminov/bensuppl.htm

No URL given for: Directory of Least-toxic Pest Control Products
URL to add: http://www.birc.org/

Page 3-32 [no URLs given on this page, not critical]
No URL given for: California Stormwater Best Management Practice Handbook
URL to add: http://www.cabmphandbooks.com/

No URL given for: Guidance Manual for Onsite Stormwater Quality Control Measures
URL to add:
http://www.sacramentostormwater.org/documents/newdevelopment/Jan2000_On-site_GuideMan.pdf

**Note: correct the spelling of Onsite (change to On-Site as written on the document.) There are several instances of this reference.*

No URL given for: Stormwater Treatment, Biological, Chemical and Engineering Principles
URL to add: http://www.stormwaterbook.com/

No URL given for: Stormwater Quality Design Manual for the Sacramento and South Placer Regions
URL to add:
http://www.msa.saccounty.net/sactostormwater/SSQP/documents/DesignManual/SWQ_DesignManual_May07_073107.pdf

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

Page 3-38 [no URLs given on this page, not critical]
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Page 3-38
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http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_4/bmps/3.pdf

Page 3-56 [no URLs given on this page, not critical]
No URL given for: California Stormwater Best Management Practice Handbook
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http://www.lowimpactdevelopment.org/lidpercent20articles/stormwater_feb2003.pdf
New URL: http://www.lowimpactdevelopment.org/lid%20articles/stormwater_feb2003.pdf

Broken URL: http://www.deq.state.id.us/water/stormwater_catalog/doc_bmp44.asp
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http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_4/bmps/9.pdf

Broken URL: http://www.cityofreno.com/gov/pub_works/storm water/management/controls/
New URL: http://www.cityofreno.com/Index.aspx?page=1007

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

Page 3-61 [no URLs given on this page, not critical]

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http://www.sacramentostormwater.org/documents/newdevelopment/Jan2000_On-site_GuideMan.pdf

Page 3-62

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

No URL given for: California Stormwater Best Management Practice Handbook
URL to add: http://www.cabmphandbooks.com/

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

Page 3-70 [no URLs given on this page, not critical]

No URL given for: California Stormwater Best Management Practice Handbook
URL to add: http://www.cabmphandbooks.com/

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

Page 3-76

No URL given for: Stormwater Technology Fact Sheet: Porous Pavement
URL to add: http://www.epa.gov/npdes/pubs/porouspa.pdf

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http://www.psat.wa.gov/Publications/LID_tech_manual05/LID_manual2005.pdf
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Broken URL:
http://www.toolbase.org/tertiaryT.asp?TrackID=&DocumentID=2160&CategoryID=38
New URL: http://www.toolbase.org/Technology-Inventory/Sitework/permeable-pavement

Page 3-80

Broken URL: http://www.unce.unr.edu/publications/SP93/SP9302.pdf
New URL: http://www.unce.unr.edu/publications/files/ho/other/sp9302.pdf

Broken URL:
http://www.psat.wa.gov/Publications/LID_tech_manual05/LID_manual2005.pdf
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Page 3-83 [no URLs given on this page, not critical]

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http://www.sacramentostormwater.org/documents/newdevelopment/Jan2000_On-site_GuideMan.pdf

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

Page 3-87 [no URLs given on this page, not critical]

No URL given for: LID Technical Guidance Manual for the Puget Sound
URL to add: http://www.psp.wa.gov/downloads/LID/LID_manual2005.pdf

No URL given for: Urban Storm Drainage Criteria Manual, Volume 3
URL to add: http://www.udfcd.org/downloads/down_critmanual.htm

Page 3-93

No URL given: Sustainable Site Design
Possible URL to add: http://www.thcahill.com/documents/apwa-optimized-2pg-screen.pdf

No URL given: Raising the Bar on Green Roof Design
URL to add: http://www.asla.org/land/050205/pdf/Greenroof_articleLAM11_06.pdf

No URL given: ECOROOFS – Questions and Answers
URL to add: http://www.portlandonline.com/shared/cfm/image.cfm?id=53987

Page 3-97 [no URLs given on this page, not critical]

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No URL given for: Guidance Manual for Onsite Stormwater Quality Control Measures
URL to add:
http://www.sacramentostormwater.org/documents/newdevelopment/Jan2000_On-site_GuideMan.pdf

Attachment B: Appendix G Review Comments

Suggested Edits for Appendix G:

Appendix G Title Page: LID Planting Zones and Plant List

Consider expanding the title to something more inclusive such as, "LID Planting Zones, Plant List and Planting Guidelines." Later in the document, the terminology "LID Plant Palette" is used. Consider using that term as part of the section title.

The term Planting Zone is usually used for larger scale (i.e. Sunset Zone 10). Rather than Low Impact Development Planting Zones, a more precise term would be Low Impact Development Moisture Zones.

Page G-1:

Consider adding "LID" (or Low Impact Development) in front of Planting Zones.

Clarify that "LID Planting Zones" do not address green roofs or street trees, which are also LID practices. These LID Planting Zones refer to the planting position in a cross section profile of a bioretention basin, bioswale, or vegetated swale. Plants suitable for green roof or street trees are designated as such in the plant list, but the plant list is not a complete list of green roof plants or street trees for Salinas.

Consider adding a sentence at end of the second paragraph that states, "All planting zones in bioretention areas or vegetated areas will be subject to periods of extreme dryness. The purpose of rating the zones within the profile is to provide a relative moisture range and to define the typical moisture regime which plants will experience."

LOW ZONE - A better description would refer to its moisture status so that a practitioner would understand the growing conditions within a profile by its nomenclature. (i.e., Floodplain/Wet/Hydric)

At the end of the "Low Zone" paragraph consider adding, "All plants selected should be tolerant of periods of drought. Typically, facultative wetland species have this biological capability."

MID ZONE – Mesic – moist, well drained conditions with periods of drought. Depending on orientation, this will either be an extremely dry slope (facing S/SW) or moderately dry slope (facing N/NE)

HIGH ZONE – Upland/Dry/Xeric - This area will be very dry relative to the profile. Deep rooted plants should be preferred as they will be most drought tolerant. Typically Facultative Upland plants perform best under these conditions. Depending on the plant selection throughout the swale, plants in this area may or may not have shaded roots from the lower lying plants.

Pages G-2 & G-3:

Consider moving the green roofs and the two planting strips to precede the three moisture zone columns. Indicate that the green roof list is not a full list. Most plants that qualify for consideration for a green roof would qualify for inclusion in the "High Zone" based on moisture, but some may need to be excluded due to root structure.

Add minimum soil volume requirements for tree health (varies by tree).

Include the criteria (water requirements, tolerance for inundation, root and leaf structure and ability to filter pollutants (and which pollutants, if known)) in the Notes column or add columns.

Create a finer division of plant materials. Divide trees, shrubs and grasses/perennials into height/size categories so that appropriate height/spread decisions may be made for plant selections (or include in a column).

Add visual aspect information (habit, feature of interest, etc).

Add exposure (i.e. Full Sun, part sun/shade, shade) to descriptions.

Indicate desirable spacing range for each plant.

Populus fremontii will thrive in the low lying areas due to the moisture and the sandy bioretention mix. They are a pioneer species and may cause maintenance issues as they "move" themselves into their preferred habitat. Their root volume may be too large for the bioretention cell.

While Pseudotsuga menziesii spp menziensii (Coast Douglas Fir) is indigenous to this area, it may be too large a tree for bioretention areas and may not tolerate the extremes of conditions in a bioretention setting in the Salinas area.

Salix coulteri (Salix sitchensis) Sitka Willow (name has changed http://plants.usda.gov/java/nameSearch)

Omit any plants with descriptions such as "can be invasive" (i.e. Rosa californica) or at least note its other description "thorny Velcro."

Salvia spp – Needs a note "requires good drainage" (check box)

Vitis californica grows well with plenty of moisture but the notes indicate it should not be planted in at a low point. Omit the reference to placing it in the "Low Zone" and only show it as for the mid and high zones.

Pages G-4 & G-5:

Design Criteria
Add to planting criteria list:

- Tolerance to pollutant surges

Define "Adaptability"; many plants that are adaptable are invasive.

In the second paragraph, second column, "Trees and large shrubs are best planted in the high zone where their roots can absorb the infiltration". What is meant by this statement? As shown in the profile, planting media soils are deepest in the "low" zone. "Absorb the infiltration" is not what plants do; they evopotranspire, they uptake moisture, but they do not absorb infiltration. The Populus would be just as vigorous in the low areas as the high areas and may show less drought stress. Many of the shrubs listed would do well in the wettest areas, and some of the trees too.

Plant Layout
A note should be added indicating the desirability of closer spacing using smaller plants to ensure rapid cover and plant adaptation to the growing conditions.

Sections which would be desirable to include:

- Native Plant associations which have appropriate species (i.e. Coastal Sage Scrub, Riparian, etc)
- Planting media specification/ installation
- Plant size recommendations and spacing
- Planting detail
- Planting staking detail
- Plant mature size
- Plant attributes – this could be added to the plant list , see notes above and a graphic silhouette detailing desirable attributes (branching structure, root structure etc) added
- Planting procedures:
  - Plant condition/ inspection
  - Hole size / shape
  - Position of root ball at time of installation
  - Risk of compaction during installation
  - Staking
  - Mulching procedure
- Watering procedure during establishment phase and beyond
- Maintenance of vegetated BMPs
- Recommended monitoring for plant health/ how to divide plants (perennials) in a bioretention area without disrupting the SW function
- Inspection criteria
- Resource list for more information on plants for these conditions (or divide references by topic area)
  - i.e., calflora http://www.calflora.org/index0.html

Page G-6:

See notes on page G-5 regarding the resource list.

Linda S. Adams
Agency Secretary

California Regional Water Quality Control Board

Central Coast Region

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July 10, 2008

FOLLOW UP TO NOTIFICATION TO TRADITIONAL, SMALL MS4s REGARDING PROCESS FOR ENROLLING UNDER THE STATE'S GENERAL NPDES PERMIT FOR STORMWATER DISCHARGES

On February 15, 2008, I sent a letter to you with my expectations regarding the content of Storm Water Management Plans (SWMPs), and an explanation of our process for enrolling traditional, small Municipal Separate Storm Sewer Systems (MS4s) under the State's General Storm Water Permit. This letter responds to feedback we received regarding my February 15 letter and is a follow up to the meetings we have had with several municipalities.

This letter presents:

- An example approach for including quantifiable measures of healthy watersheds in stormwater management programs
- Additional time for developing interim hydromodification criteria
- Reiteration of our authority to provide expectations for SWMP content
- The current status of the enrollment process
- The availability of technical and financial assistance

My February 15 letter emphasized that SWMPs must include BMPs to achieve the following conditions, which are necessary to ensure protection of water quality, beneficial uses, and the biological and physical integrity of watersheds and aquatic habitat:

I. Maximize infiltration of clean stormwater, and minimize runoff volume and rate
II. Protect riparian areas, wetlands, and their buffer zones
III. Minimize pollutant loading; and
IV. Provide long-term watershed protection

My February 15 letter specifically required your SWMP to include an "Evaluation of Program Effectiveness and Progress toward Water Quality Goals." This means that your SWMP must identify quantifiable measures to determine whether your stormwater program achieves the conditions (I.-IV.) above and any other water quality goals your SWMP is designed to achieve (e.g., pollution reduction). In my February 15 letter I included interim requirements for hydromodification control that could serve as quantifiable measures and that I considered adequate for recommending SWMP approval to our Board.

Several responses to my February 15 letter requested that I consider different interim requirements for hydromodification control that could serve as quantifiable measures for recommending SWMP approval to our Board. This information is discussed in the next section on quantifiable measures, below. We also received requests for additional time to align SWMPs with my expectations. This issue is discussed below under **Additional Time for Developing Interim Criteria for Hydromodification.** Finally, some responses questioned our legal authority to base SWMP approvals on the expectations I presented in the Feb. 15 letter and claimed that they are not necessary for compliance with the State General Permit. This issue is discussed below under **Legal Authority to Provide Expectations for SWMP Content**.

The list of goals above (listed as I. through IV.) includes our expectation that you "provide long-term watershed protection." This means that your SWMP must include a schedule (of BMPs) to integrate all stormwater management control measures into all aspects of land use planning and development (municipal plans, policies, ordinances, codes, conditions of approval, etc.) to attain/protect healthy watersheds. Municipalities must understand the specific water quality and watershed issues in their areas, such as pollutant loading, aquatic habitat degradation, types of land uses and their impacts, trends, and the cumulative effects from multiple municipalities in a watershed. Municipalities must plan comprehensively to define their future growth, including infrastructure and redevelopment, in the context of long-term watershed protection. I recommend that municipalities located in the same watershed work together and pool resources to define water quality and watershed scale issues, and assess watershed conditions, in a coordinated manner. This type of collaborative approach is being used by almost 3000 farmers in our region, as they also learn how to comply with the Water Board's requirements to define and resolve water quality and watershed scale issues. Farmers in our region established a non-profit organization that coordinates and streamlines their compliance efforts, helps minimize costs, and helps disseminate information among farmers and between farmers and the Water Board.

We acknowledge the challenge this presents, and that it will take years for municipalities to learn how to incorporate and implement these changes beyond the project or site-specific scale. It will take time to build the institutional capacity to do the work, and to measure results. Please see the section at the end of this letter on the availability of financial and technical assistance.

An Example Approach for Including Quantifiable Measures of Healthy Watersheds in Stormwater Management Programs

The attached information may help you develop quantifiable measures of healthy watersheds, including numeric criteria for hydromodification control and watershed protection controls. The information is not comprehensive, but provides examples to demonstrate how a control measure should be linked to, a) a desired condition (or goal), b) the parameter(s) that define the condition, and c) quantifiable measures that serve to evaluate performance of the control measure. We will use this type of approach to evaluate the control measures and quantifiable measures (including interim criteria for hydromodification controls) in your SWMPs.

We recognize that different Phase II communities are at different junctures in developing or implementing their SWMPs and selecting quantifiable measures. Thus, the attached information may assist you in different ways; for example, it may assist your selection of interim hydromodification criteria, or, it may help you improve your SWMP's measures of long-term performance.

Additional Time for Developing Interim Criteria for Hydromodification

My February 15 letter stated that we expect you to implement our interim requirements for hydromodification control for all projects subject to your agency's discretionary approvals within six (6) months of your enrollment in the Phase II General Permit, i.e., when your SWMP is approved by the Executive Officer or adopted by the Water Board. In response to the feedback we received, we are providing flexibility in three ways: 1) I am providing you an additional six (6) months, (to make it a full year), before you apply interim criteria for hydromodification control, 2) I am willing to consider other hydromodification control criteria that you develop, if they are reasonably equivalent to those I specified in my February 15 letter, and 3) I am willing to consider the applicability of hydromodification control criteria based on local conditions.

Water Board staff's expectation is that within one year of enrollment under the General Permit, you will have adequate development review and permitting procedures to impose conditions of approval, or other enforceable mechanisms, to implement quantifiable measures (numeric criteria) for hydromodification control. Your SWMP must include a commitment and a schedule to develop any alternative interim criteria, should you choose to develop them. If you fail to develop alternative criteria acceptable to the Water Board, you will be subject to our interim criteria as stated in the February 15 letter.

We are available to discuss hydromodification control measures (BMPs), acceptable numeric criteria for those controls, and the criteria for their application (applicability criteria). If you intend to develop your own interim criteria for hydromodification control, please include your schedule for developing the criteria in your SWMP and allow for a period of no less than three (3) weeks for Water Board staff to review the proposed criteria. Water Board staff will also consider economic factors in reviewing hydromodification control criteria and applicability criteria.

To ensure our allowance of additional time does not come at a cost to watershed health, we propose that by our original six-month date, you inform property developers that, in the absence of established detailed criteria (interim or otherwise) for hydromodification control, you only approve and permit projects that incorporate substantive hydromodification evaluation and controls (that is, the developers can propose their own approach to meet the intent until detailed criteria are established).

Legal Authority to Provide Expectations for SWMP Content

As noted in my February 15 letter, the federal Clean Water Act (CWA) provides that National Pollutant Discharge Elimination System (NPDES) permits for MS4s must require municipalities to reduce pollutants in their stormwater discharges to the Maximum Extent Practicable (MEP) (CWA §402(p)(3)(B)). The California Water Boards have established the meaning and application of this standard through several adopted stormwater permits (the MEP standard is the same for Phase I and Phase II municipalities)[1]. The Water Board implements the General Permit to be consistent with its Water Quality Control Plan (Basin Plan) to ensure protection of water quality, beneficial uses, and the biological and physical integrity of watersheds according to the issues in the Regions. The General Permit contemplates that low impact development will be a component of

[1] Several stormwater permits adopted by different Regional Boards have been legally challenged. All have been upheld by the State Water Resources Control Board and the courts. The Water Boards have broad authority to regulate stormwater and land use activities that result in discharges to waters of the State. Urbanization is one the most important land use activities affecting water quality, beneficial uses, and the physical and biological integrity of watersheds in the Central Coast Region.

SWMPs. See Fact Sheet to General Order at page 6. The General Permit also requires the SWMP to contain measurable goals, including, for example, percent reduction in pollution load. The General Permit has been in effect for nearly five years and the Central Coast Water Board expects that Phase II communities will have benefited from their own experience and other communities in developing a robust SWMP. The General Permit expects Phase II communities to learn from Phase I communities in implementing MEP. The February 15 letter did not require that each community include the specific recommendations, but rather stated that the Executive Officer would not approve a SWMP that does not include adequate low impact development BMPs and measurable goals. Our approach, including our February 15, 2008 letter, is consistent with the General Permit.

Current Status of Enrollment Process

Since initiation of the new enrollment strategy, several enrollment cycles have begun. Table 1 presents the status of the cycles. Please check our website for more specific scheduling information and notices for public comment periods.
http://www.swrcb.ca.gov/rwqcb3/stormwater/index.htm

Availability of Technical and Financial Assistance

Several grant programs are currently available to provide matching grants to local public agencies to protect watersheds, reduce and prevent stormwater pollution, and implement LID planning and design principles and practices. These programs include California Proposition 84 Storm Water funds, California Proposition 1E Flood Prevention and Stormwater Management, and the US EPA West Coast Estuaries Initiative. I encourage you to pursue these grant opportunities. For more information specifically on the Proposition 84 Storm Water Grant Program and workshops, visit the State Water Board's website at:
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/prop84/index.shtml

You may also contact our grant manager, Angela Schroeter, at 805-542-4644, or at ASchroeter@waterboards.ca.gov, regarding these grant opportunities.

The Water Board is also providing partial funding for a Central Coast Low Impact Development Center. The Center will assist municipalities, engineers, and developers to implement Low Impact Development on the Central Coast. We anticipate technical assistance will be available from the Central Coast LID Center office starting fall 2008. In the meantime, we encourage you to contact the LID Center of Maryland (http://www.lowimpactdevelopment.org/), as they have extensive experience in helping municipalities implement LID throughout the Unites States, including California. We also encourage you to contact other professionals who are qualified to implement LID and watershed protection, such as the Center for Watershed Protection (www.cwp.org and www.stormwatercenter.net), and The Center for Water and Land Use (http://extension.ucdavis.edu/unit/center_for_water_and_land_use/about.asp) to use their many technical and educational resources (many of which are free). These services will help you create the institutional capacity to integrate all stormwater management control measures into all aspects of land use planning and development (municipal plans, policies, ordinances, municipal codes, conditions of approval, etc.) to protect healthy watersheds.

Table 1: Status of Enrollment Cycles for Attachment 1 and 2 MS4s

Cycle	MS4 Group	Group Members	Projected Start Date for Enrollment Cycle	Projected Executive Officer SWMP Approval	Projected Board SWMP Approval[2]	Staff Phone (805 Area Code)
1	Santa Maria	Santa Maria	Underway	August 11, 2008	Sept. 5, 2008 San Luis Obispo	Dominic Roques 542-4780
2	Coastal Santa Barbara County	Goleta Carpinteria Santa Barbara UC Santa Barbara Lompoc *(originally in Cycle 1)*	Underway	September 2, 2008	Oct. 17, 2008 Santa Barbara	Brandon Sanderson 549-3868
3	Santa Cruz Mountains and Coast	Santa Cruz County Watsonville City of Santa Cruz Scotts Valley UC Santa Cruz	Underway	February, 2009	March 6, 2009 San Luis Obispo	Phil Hammer 549-3882
4	Coastal San Luis Obispo County	Arroyo Grande Grover Beach Pismo Beach Oceano CSD Morro Bay Los Osos CSD	Underway	January 2009	2009 – 1st Quarter San Luis Obispo	Tamara Presser 549-3334
5	Upper Salinas	King City Templeton Atascadero	June 2008	February 2009	2009 – 1st Quarter Salinas	David Innis 549-3150
6	City of San Luis Obispo	City of San Luis Obispo	Underway	April 2009	2009 – 2nd Quarter San Luis Obispo	Tamara Presser 549-3334
7	Upper Pajaro	Gilroy San Martin Santa Clara	Early November 2008	August 2009	2009 – 3rd Quarter Watsonville	Dominic Roques 542-4780
8	Santa Ynez	Buellton Solvang Vandenberg AFB	Mid November 2008	August 2009	2009 – 3rd Quarter San Luis Obispo	Dominic Roques 542-4780

Agencies, municipalities, and consultants are all on a learning curve with respect to stormwater management, LID implementation, and watershed protection. Water Board staff are not design or planning experts, and as with all of our requirements, we cannot legally tell those we regulate how to comply. Municipalities must build their capacity to be able to comply with the Board's requirements. This includes hiring qualified personnel to develop and implement SWMPS, and providing the most up to date, relevant education on an ongoing basis. When relying on consultants, it is critical that you carefully consider the qualifications and experience of the professionals you retain. Many consulting firms are on the same learning curve as agencies and municipalities.

If you have any questions regarding this letter, please contact **Dominic Roques**, at

[2] Board approval only required if a hearing is requested by stakeholder

droques@waterboards.ca.gov or at **(805) 542-4780.** If you have any questions regarding the status of a particular enrollment cycle, please contact the staff person indicated in Table 1.

Thank you for your commitment to developing a SWMP that will support healthy watersheds in the Central Coast Region.

Sincerely,

Roger W. Briggs
Executive Officer

Cc:
Hillary Hauser, Heal The Ocean
Steve Shimek, The Otter Project
Kira Redmond, Santa Barbara ChannelKeeper
Christine Sotelo, SWRCB
Chris Crompton, California Stormwater Quality Association
Jerry Bunin, Homebuilders Association of the Central Coast

Attachment: An Example Approach for Including Quantifiable Measures of Healthy Watersheds for Stormwater Management Programs

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An Example Approach for Including Quantifiable Measures of Healthy Watersheds in Stormwater Management Programs

The Water Board implements the General Permit for Phase II Stormwater Dischargers to be consistent with the Central Coast Water Quality Control Plan to ensure protection of water quality, beneficial uses, and the biological and physical integrity of watersheds in the Central Coast Region. The Water Board's Executive Officer requires Storm Water Management Plans (SWMPs) to include BMPs that achieve the following, which are necessary to ensure protection of water quality, beneficial uses, and the biological and physical integrity of watersheds and aquatic habitat:

I. Maximize infiltration of clean stormwater, and minimize runoff volume and rate
II. Protect riparian areas, wetlands, and their buffer zones
III. Minimize pollutant loading; and
IV. Provide long-term watershed protection

Together these objectives support healthy watersheds and SWMPs must identify quantifiable measures to determine whether stormwater programs achieve these objectives. Water Board staff must have quantifiable measures by which to evaluate compliance with the General Permit.

Using the Example Approach

The attached table may assist you in developing quantifiable measures of healthy watersheds, including hydromodification control criteria. It identifies the *desired conditions* of healthy watersheds affected by stormwater, including hydrologic and geomorphic conditions and the habitat conditions they drive. The table also identifies *control measures* that function to protect, support, or restore desired conditions. The table then identifies *parameters* and *proxy parameters* that describe these desired conditions. And finally, the table includes examples of *quantifiable measures* associated with particular parameters.

Water Board staff expects SWMPs to rely on a variety of control measures to achieve the desired condition of healthy watersheds. Each control measure should be linked to a desired condition, the parameter(s) that define that condition and quantifiable measures that serve as performance goals for the control measure. The following example illustrates how the framework can be used:

> Example:
> Optimal riparian habitat is a desired condition of healthy watersheds. One parameter that describes optimal riparian habitat is the width of the riparian area. A specific dimension – a width of 100 feet – can be established as a quantifiable measure of the width parameter. The result, a control measure or Best Management Practice, requiring the establishment of riparian setbacks of 100 feet, supports the goal of maintaining a healthy watershed. As this example illustrates, some control measures and quantifiable measures can be applied beyond the site scale up to the watershed scale.

Desired Conditions of Healthy Watersheds

Desired conditions of healthy watersheds are defined here as the physical attributes and processes that are characteristic of watersheds possessing the essential water quality condition of physical and biological integrity. These conditions include observable and measurable outcomes in the landscape and watershed that are aligned with the Central Coast Water Board's vision of healthy watersheds and are consistent with our Basin Plan. Our vision is the

attainment of healthy watersheds throughout the Central Coast Region by 2025. To that end, we have defined the following desired conditions of healthy watersheds:

A. Rainfall surface runoff at pre-development levels,
B. Watershed storage of runoff, through infiltration, recharge, baseflow, and interflow, at pre-development levels,
C. Watercourse geomorphic regimes within natural ranges (stream banks are stable within natural range; sediment supply and transport within natural ranges), and
D. Optimal riparian and aquatic habitats (including: stream flow, in-channel, water column, and biotic conditions).

Direct Parameters
Parameters are accurate and precise descriptions and elements of desired conditions. The parameters listed in the attached table are examples of those conventionally used to describe, characterize and/or evaluate the conditions. Direct parameters allow direct examination, description, or assessment of a desired condition.

Proxy Parameters for Applying Quantifiable Measures
Proxy parameters, while still descriptors of the desired condition, lend themselves to quantifiable measurement more readily than direct parameters. Proxy parameters are often used where there are impediments to directly measuring the elements or attributes of a desired condition.

Quantifiable Measures
Quantifiable measures include numeric criteria and metrics applied to a particular parameter. For example, specific hydrograph criteria are quantifiable measures used to ensure post-development runoff volumes are equivalent to pre-development runoff volumes. For some conditions and their parameters it is challenging to develop quantifiable measures, or criteria. For example, broad consensus is lacking on the appropriate criteria for Large Woody Debris (LWD) in streams, an important component of in-channel aquatic habitat in fish-bearing streams. For the LWD parameter, research continues on the appropriate amount of LWD necessary to maintain its roles in providing habitat and structural complexity to stream channels. In such cases, managers can select provisional targets as interim criteria for a parameter and employ adaptive management to improve on the criteria over time.

Hydromodification Control Criteria: Quantifiable Measures (i.e., numeric criteria) for hydromodification are an important component of stormwater management programs. Hydromodification refers to the effects of urbanization on runoff and stream flows that in turn may cause erosion and/or sedimentation in stream channels. Throughout the State, hydromodification is a major cause of most current and future water quality issues associated with urban runoff and is also a major cause of flooding. Projected population growth, and pressure to develop new landscapes, compounds this problem. Hydromodification control aims to prevent erosion in stream channels that receive runoff from new and redevelopment areas. Hydromodification control is clearly important to maintaining or achieving the desired condition of healthy watersheds and Water Board staff will continue to require hydromodification control for new and redevelopment. Healthy watershed conditions associated with surface runoff (A, above), watershed storage (B), and geomorphic regimes (C) are typically the subjects of hydromodification management planning and assessment. Such planning and assessment can provide a basis for establishing regionally specific hydromodification control. Examples of quantifiable measures for hydromodification are identified in the table with a check mark in the column "HMC" (Hydromodification Criteria).

Watershed Protection Criteria: Quantifiable Measures (i.e., numeric criteria) for watershed protection are also an important component of stormwater management programs. Watershed protection means integration and incorporation of stormwater management control measures that support healthy watersheds into all aspects of land use planning and development. Watershed protection aims to preserve and protect riparian areas, wetlands and aquatic habitats (D, above) while a variety of land uses, including urban development, continue in the watersheds. Examples of quantifiable measures for watershed protection are included in the table as well (Richards-Baker Flashiness Index, continuous flow duration curves, stream setback criteria, Effective Impervious Area thresholds, and Basin Plan Water Quality Objectives).

Control Measures

Control measures include best management practices (BMPs) that contribute to sustaining the desired conditions of healthy watersheds. For example, control measures requiring Low Impact Development, discussed below, applied to new development, can directly maintain pre-development runoff rates on many sites. Some control measures are more indirect in their effect on desired conditions. For example, hydrograph management can contribute to maintaining sediment supply within a natural range – desired condition C – by maintaining the frequency and timing of flows that transport sediment. However, maintaining frequency and timing of flows cannot compensate for a lack of sediment caused by an upstream dam for example. Additionally, control measures requiring riparian setbacks protect riparian and aquatic habitats.

Low Impact Development (LID):

LID is a land planning and design strategy with the goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic site design. Hydrologic functions of storage, infiltration and ground water recharge, as well as the volume and frequency of discharges are maintained through the use of integrated and distributed micro-scale stormwater retention and detention areas, reduction of impervious surfaces, capture and reuse of runoff, and the lengthening of runoff flow paths and flow time. Other related strategies include the preservation/protection of environmentally sensitive site features such as riparian buffers, wetlands, steep slopes, valuable (mature) trees, flood plains, woodlands, and highly permeable soils. LID is a preferred site scale control measure because it integrates measures that address all of the desired conditions of a healthy watershed. In fact, the term "Integrated Management Practices" (IMPs) is often used in lieu of the term LID.

Watershed Scale Control Measures:

Subwatershed or watershed planning can be undertaken through general planning, specific area planning, and district planning. Such planning results in municipal plans, policies, ordinances, codes, etc., that improve or protect desired conditions of healthy watersheds (A-D above). Staff at the Central Coast Water Board expect Storm Water Management Programs to include strategies for conducting watershed-based planning that yield control measures beyond the site-specific or individual project scale. Such planning should be conducted to determine how best to integrate site-specific scale stormwater management control measures into all aspects of land use planning and development. For example, a riparian setback can be applied to individual development proposals on a case-by-case basis as a generally protective site level control. However, watershed-scale planning may indicate that development should be restricted within a setback distance for designated reaches of a stream, as a sub-watershed or watershed scale control, to protect identified sensitive habitat, take advantage of a high value stream

recharge zones, or prevent potential downstream hydrologic impacts. To that end, several of the parameter/quantifiable measure combinations identified in the attached table are useful both in evaluating watershed scale controls, and the effect of site controls at the watershed scale (e.g., Richards-Baker Flashiness Index, Continuous flow duration curves, stream setback criteria, Effective Impervious Area thresholds, and Basin Plan Water Quality Objectives).

The attached table includes a small selection from the abundance of site-specific scale control measures available to achieve healthy watershed conditions. However, the blanket application of site-specific scale requirements invariably yields unintended consequences. Applicability criteria, which define what types of projects and under what circumstances controls and quantifiable measures apply, are a necessary component of effective implementation. The challenge in developing applicability criteria is to require control measures sufficient to achieve the desired effect on watershed conditions, while avoiding unintended outcomes. For example, hydrologic performance should not outweigh other important environmental goals such as infill, redevelopment priorities, and regional growth patterns that can also affect watershed health. An example from a report recently commissioned by the California Ocean Protection Council illustrates a limitation of site scale control measures:

> *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. [1]

To achieve the appropriate balance of environmental and societal goals, stormwater managers should consider and select control measures (BMPs) and applicability criteria at a watershed scale. The effect of exemptions from hydromodification control requirements for individual projects for example, must be examined from a broad enough perspective to determine whether the desired conditions of healthy watershed are achieved. There is a growing belief that subwatershed planning is the best structure for matching control measures to runoff stressors (ibid).

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[1] *State and Local Policies Encouraging or Requiring LID in California, Attachment 1, p. A-12, Prepared by Tetra Tech Inc. for the California Ocean Protection Council, January 2008.*

Table: Framework to Support Development of Quantifiable Measures of Healthy Watersheds for Stormwater Management Programs

Control Measure	Direct Property	Quantifiable Measure	Example Quantifiable Measure	HMC	Ref.
DESIRED CONDITION = SURFACE RUNOFF AT PRE-DEVELOPMENT LEVELS					[2], [3]
Hydrograph Mgmt LID BMPs	Volume Rate Duration Timing	Continuous Flow Duration Curves	The post-project-project discharge rates and durations shall not deviate above the pre-project rates and durations by more than 10% over more than 10% of the length of the flow duration curve, for flow rates from 20% of the pre-project 5-yr runoff event to the pre-project 10-yr runoff event.	✓	12, 16
		Event-Based Hydrograph Matching	For storms up to the 2-yr, 24-hr recurrence interval, the volume of runoff that leaves a site must not exceed the volume that would occur from the site under fully forested condition, given the soils present	✓	6, 14, 31
		Drainage Density	Preserve predevelopment drainage density for all drainage areas serving a first order stream or larger	✓	11
		Time of Concentration	Ensure that post-project time of concentration is equal or greater than pre-project time of concentration	✓	11
		Effective Impervious Area (EIA)	EIA less than or equal to 5% of total project area	✓	5, 9, 16, 21, 27, 28,
		Richards-Baker Flashiness Index	Not Available		1
DESIRED CONDITION = NATURAL WATERSHED RUNOFF					
Hydrograph Mgmt LID BMPs	Infiltration Groundwater flow & recharge Interflow Baseflow	Time of Concentration Drainage Density Flow duration curves Groundwater elevations	SAA[4] SAA SAA Not Available		
		Event-based hydrograph matching	SAA		
		EIA	SAA		
DESIRED CONDITION = STREAM BANK STABILITY WITHIN NATURAL RANGE					
Stream Bank Stability[5] within Natural Range					
Riparian Buffers Stream Setbacks In-stream Grade-Control	Entrenchment Width-Depth Ratio Bank Failure	Stream Setback Width	100-feet setback on streams of first order and above		2, 18

[2] Hydromodification Control (HMC).
[3] Citations (see end of Table) include source of example Quantifiable Measure and/or select supporting literature and documents.
[4] SAA = Same As Above. Quantifiable Measure example is same as the above Quantifiable Measure for the specified parameter.
[5] Stream bank stability: a condition in which the sediment sizes and loads, water discharges, and channel shapes and slopes are in balance.

		Channel Enlargement Ratio	Channel enlargement ratio must either stay below 1.0 or not increase from the pre-development enlargement ratio.		15
		Riparian Buffer (width, density)	Forest buffers shall be a minimum of 100 feet wide, with the requirement to expand the buffer depending on: 1) stream order[6], 2) percent slope, 3) 100-year floodplain, 4) wetlands or critical areas.		7, 10
			Streamside zone[7] shall extend a minimum of 25 feet from top of bank and shall be maintained as a mature forest; Middle zone shall extend a minimum of 50 feet, plus additional buffer width if necessary, and shall be a managed forest with some allowable clearing; Outer zone shall extend a minimum of 25 feet and shall encourage forestation (Note: Refer to citation for allowed uses within each zone.)		2, 7
		Drainage Density	SAA		
		Time of Concentration	SAA		
Sediment Supply within Natural Range					
Erosion and Sediment Control Riparian Buffers Stream Setbacks In-stream Grade-Control Structures Hydrograph Mgmt LID BMPs	Loads Frequency Sediment Size	Settling Time	Adequate detention volume shall be available to permit 90% Total Suspended Solids (TSS) removal of runoff leaving the site for a 2-yr, 24-hr storm event.		9, 24
		Suspended Sediment Concentration	Not Available		
		Annual Sediment Yield	Post development annual sediment yield[8] shall closely mimic pre-development annual sediment yield.		29
		Riparian Buffer (width, density)	SAA		
		Stream Setback Width	SAA		
		Drainage Density	SAA		
		Time of Concentration	SAA		
Sediment Transport within Natural Range					

[6] Stream order is a method of classifying streams in an order of hierarchy starting with first-order streams, which are comprised of headwater streams with no upstream tributaries. Second-order streams are formed below the intersection of two first-order tributaries; third-order streams are formed below the intersection of two second-order streams, and so on.

[7] Streamside Zone (Zone 1): Extends from stream edge of the active channel to top of bank. The streamside zone function is to protect the physical and ecological integrity of the stream ecosystem. Middles Zone (Zone 2): Extends from streamside zone to outer zone. The middle zone functions are to protect key stream components and to provide distance between the upland development and streamside zone. Outer Zone (Zone 3): Extends from middle zone to nearest permanent structure. The outer zone functions are to prevent encroachment into the buffer zone and to filter urban runoff.

[8] Sediment yield (annual): Product of annual gross erosion (tons/unit area) and sediment delivery ratio (less than 1).

Hydrograph Mgmt LID BMPs	Rate Scour Fill Armoring	Flow duration curves EIA Drainage Density Time of Concentration Event-based hydrograph matching	SAA SAA SAA SAA SAA		
DESIRED CONDITION					
Riparian and Wetland Habitat Optimal					
Setback Requirements: Streams, Wetlands		Setback Dimension	Minimum Buffer on each side of stream = 98 feet to 1,640 feet+		10
Riparian Buffers	Buffer Dimension & Density	Riparian Buffer (width, density)	SAA		
		Alluvial Groundwater Elevation	Not Available		20
	Bank Erosion/Failure	Bank Erosion Potential Index	Not Available		3
LID BMPs Hydrograph Mgmt					
Aquatic Habitat Optimal					
Clean Water					
LID BMP (filtration) Filters Active Treatment	Water Column Physical and Chemical Parameters		Basin Plan Water Quality Standards		4
			For projects that install stormwater treatment systems which function primarily as infiltration devices, the Permittee shall require that: (a) Appropriate pollution prevention and source control measures are implemented to protect groundwater at the project site, including the inclusion of a minimum of 2 ft of fine grain soil in the infiltration flow path of the infiltration system; (b) Adequate maintenance is provided to maximize pollutant removal capabilities		13
			Treatment systems whose primary mode of action depends on flow capacity shall be sized to treat: (a) 10% of the 50-yr peak flowrate; (b) The flow of runoff produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity for the applicable area, based on historical records of hourly rainfall depths; or (c) The flow of runoff resulting from a rain event equal to at least 0.2 inches per hour intensity.		13
		Pollutant Loading	Annual pollutant loading in site runoff, calculated for all Pollutants of Concern (POCs) specified by the municipality for the site, shall not increase from pre-development conditions to post-development conditions.		25, 5
Detention with Settling		Detention Time	Draw down time no less than 24 hours		N/A
			Turbidity shall not exceed levels that will adversely impact fish.		17
Stream Flow: Velocity, depth, timing					

Hydrograph Mgmt		Event-Based Hydrograph Matching	Flow requirements for fish same as above		31
In-Channel Conditions					
	Stream Substrates	Particle Size Distribution: percent coarse fine sediment less than 0.6 mm in spawning gravels	Less than or equal to 30% by wet volume		8
	Pools and Riffles	Residual Pool Volume	Less than or equal to 0.21 (mean) and 0.45 (max)		8
Biota					
Hydrograph Mgmt LID BMPs	Index of Biotic Integrity		Southern California IBI		23, 21

Citations

1. "Application of the Richards-Baker Flashiness Index to Gaged Michigan Rivers and Streams." Michigan Department of Environmental Quality. August 3, 2007
2. "Aquatic Buffers." Center for Watershed Protection. June 6, 2008 <http://www.cwp.org/aquatic_buffers.htm>
3. "Bank Erosion Potential Index (BEPI) Worksheet. (The BEPI Worksheet is adapted from Rosgen, David L. "A Practical Method of Computing Streambank Erosion Rate", Wildland Hydrology Inc., Pagosa Springs, CO, 10 pp.) http://www.dnr.state.wi.us/org/water/fhp/waterway/permits/BankErosionPotentialIndexWorksheet.pdf
4. "Basin Plan." Central Coast Regional Water Quality Control Board. (8 September 1994) 9 June 2008 <http://www.swrcb.ca.gov/centralcoast/BasinPlan/Index.htm>.
5. Beach, Dana. "Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States." The Pews Oceans Commission. (8 April 2002). 11 June 2008 <http://www.pewtrusts.org/our_work_report_detail.aspx?id=30037>.
6. Booth, Derek, and Rhett Jackson. "Urbanization of Aquatic Systems – Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation." American Water Resources Association. 22.5 (1997). 9 June 2008 <http://kvue.iewatershed.com/kvue/urban_hydro_boothwrb.pdf>.
7. "Buffer Model Ordinances." The Stormwater Manager's Resource Center: Model Ordinances for Aquatic Resource Protection. 9 June 2008 <http://www.stormwatercenter.net/Model%20Ordinances/buffer_model_ordinance.htm>.
8. Central Coast Regional Water Quality Control Board. San Lorenzo River Total Maximum Daily Load for Sediment. September 20, 2002.
9. Coleman, Derrick, et al. "Effect of Increases in Peak Flows and Imperviousness on the Morphology of Southern California Streams." Southern California Coastal Water Research Project. Technical Report 450 (2005).
10. "County of Santa Clara Riparian Corridor Study." Planning Office Environmental Resources Agency, County of Santa Clara, 5 June 2003: p. 12.
11. "Draft NPDES General Permit for Stormwater Discharges Associated Construction and Land Disturbance Activities." California State Water Resources Control Board. (18 March 2008): 29 June 2008 <http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/constpermits/draft/draftconst_permit_031808.doc>.
12. "Draft Tentative Order Orange County Municipal Separate Storm Sewer System Permit." San Diego Regional Water Quality Control Board. (12 December 2007): 38. 9 June 2008 <http://www.waterboards.ca.gov/sandiego/water_issues/programs/stormwater/index.shtml>.
13. "Draft Tentative Order San Francisco Bay Region Municipal Municipal Regional Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit: Urban Runoff Quality Mgmt, Provision C.3." San Francisco Bay Regional Water Quality Control Board. (4 December 2007—Updated 14 December 2007): 21-22. 11 June 2008 <http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/muni/mrp/mrptentativeorder121407updated.pdf>.
14. "Draft Tentative Order Ventura County Municipal Separate Storm Sewer System Permit." Los Angeles Regional Water Quality Control Board. (29 April 2008): 56. 9 June 2008 <http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/ventura_ms4/08_0429/draft_Tentative_Ventura_County_MS4_Permit.pdf>.
15. "Dynamics of Urban Stream Channel Enlargement." The Practice of Watershed Protection. Article 19 (2000): 99-104.

16. Geosyntec Consultants. Memorandum to Mark Grey, Building Industry Association of Southern California: Review of Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices for Ventura County. 28 May 2008.
17. "Impact of Suspended and Deposited Sediment." The Practice of Watershed Protection. Article 14 (2000): 64-65.
18. "Impacts of Impervious Cover on Aquatic Systems, Watershed Protection Research Monograph No. 1." Center for Watershed Protection, Ellicott City, Md., March 2003.
19. "Impervious Cover Method." ENSR International. (October 2005). 11 June 2008 <http://www.epa.gov/ne/eco/tmdl/assets/pdfs/ensr_pilot/Section2.pdf>.
20. Kondolf, G.M., Maloney, L.M., Williams, J.G. "Effects of Bank Storage and Well Pumping on Base Flow, Carmel River Monterey County, California," Journal of Hydrology JHYDA7 Vol. 91, No. 3/4, p 351-369, 15 June 1987.
21. "Methods for Evaluating Wetland Condition: Developing Metrics and Indexes of Biological Integrity." U.S. Environmental Protection Agency. (2002) June 6, 2008 <http://www.epa.gov/waterscience/criteria/wetlands/6Metrics.pdf>
22. Moglen, Glenn, and Sunghee Kim. "Limiting Imperviousness." Journal of the American Planning Association 73.3 (2007): 161-171.
23. Ode, Peter R., Andrew C. Rehn, and Jason T. May. "A Quantitative Tool for Assessing the Integrity of Southern Coastal California Streams." Environmental Management. 35.4 (2005): 493-504. 12 June 2008 <http://www.ccamp.org/ccamp/documents/SoCalIBI.pdf>.
24. "Performance of Sediment Controls at Maryland Construction Sites." The Practice of Watershed Protection. Article 59 (2000): 345-347.
25. "Simple and Complex Stormwater Pollutant Load Models Compared." The Practice of Watershed Protection. Article 13 (2000): 60-65.
26. "Stormwater C.3 Guidebook." Contra Costa Clean Water Program. Third Edition (2006) <http://www.cccleanwater.org/new-developmentc3/>.
27. Sutherland, R.C. "Impervious Area Assumptions Used in Hydrologic Modeling of CWS Watersheds." Pacific Water Resources, Inc. (30 August 2005). 5 June, 2008 <http://www.cleanwaterservices.org/content/SWMP/Technical%20Memo%208-30-05.pdf>.
28. Sutherland, R.C. "Methods for Estimating the Effective Impervious Area of Urban Watersheds." The Practice of Watershed Protection. Article 32 (2000): 193-195.
29. United States Department of Agriculture: Soil Conservation Service. "Sediment Sources, Yields, and Delivery Ratios." National Engineering Handbook. Section 3. 12 June 2008 <http://policy.nrcs.usda.gov/media/pdf/neh3ch6.pdf>.
30. "Water Quality Criteria." U.S. Environmental Protection. June 6, 2008 <http://www.epa.gov/waterscience/criteria/>
31. Wenger, Seth, Tim Carter, R. Alfred Vick, and Laurie Fowler. "Runoff Limits." Stormwater Magazine. (March 2008). 9 June 2008. <http://www.stormh2o.com/march-april2008/ecologically-stormwater-management.aspx>.