Construction Industry Coalition on Water Quality

Section XII.C Proposal (Tentative Order 09-30)

The Fourth Draft Permit dated April 30, 2009 does not implement the Board's direction provided to staff at the April 24, 2009 hearing. The revised draft does not make biotreatment part of the LID standard; rather, it demotes biotreatment to an inferior status that can be used only if 100 percent on-site capture of the design storm has been demonstrated to be infeasible. This is the approach espoused by NRDC and rejected by the Board at the April 24 hearing. The Fourth Draft also fails to replace the word "strategy" in Section XII.C.3 with the word "goal," another important change agreed to at the April 24 hearing. **CICWQ urges the Board to adopt the version of the permit (Section XII.C only) called "Regulated Community Proposal (May 7, 2009)," attached hereto at Attachment A, which was prepared to conform with the Board's April 24 direction and which is a consensus proposal from the regulated community.**

I. KEY MESSAGES

The attached Section XII.C, which reflects a consensus proposal of the regulated community, is submitted with reference to the following key messages:

- The Fourth Draft adopts the NRDC approach, apparently being promoted by staff for U.S. EPA Region 9. NRDC has advocated for a narrow conception of LID, requiring on-site retention of 100% of the design storm absent a demonstration of infeasibility. This is not a practicable or desirable approach, and excludes excellent biotreatment BMPs as part of the LID standard. Nor does it provide superior water quality performance, as claimed by NRDC. The Board rejected this approach on April 24.

- The regulated community approach adds biotreatment to the LID standard, but includes a preference for the narrow LID BMPs proposed by NRDC. As we said on April 24, we will achieve 100% on-site retention as a first preference, but are concerned that, in the majority of cases, biotreatment will be important to use, and runoff from the site of development to the public storm drain will occur. Our proposal reflects this approach, allowing biotreatment in accordance with the prioritization scheme of Section XII.C.4. We believe this approach is consistent with the Board's April 24 direction.

- The Fourth Draft is inconsistent with the BMP priority scheme from the stakeholder negotiations. Neither staff, NRDC, nor U.S. EPA ever rejected biotreatment during the stakeholder negotiations from December 2008 to March 4, 2009. Rather, the regulated community thought it had reached consensus that biotreatment would be part of the LID standard, available as part of a prioritization scheme. That scheme, Section XII.C.4, was added to the permit on March 24, 2009, when staff published the Second Draft permit, clearly intended to reflect the stakeholder negotiations. Section XII.C.4 also is in the Fourth Draft permit with only minor changes since it was originally inserted on March 24, 2009. Section XII.C.4 states in full:

> *The selection of LID principles shall be prioritized in the following manner (from highest to the lowest priority): (1) Preventative measures (these are mostly non-structural measures, e.g., preservation of natural features to a level consistent with the maximum extent practicable standard; minimization of runoff through clustering, reducing impervious areas, etc.) and (2) Mitigation (these are structural measures, such as, infiltration, harvesting and reuse, bio-treatment, etc. The mitigation or structural site design BMPs shall also be prioritized (from highest to lowest priority): (1) Infiltration (examples include permeable pavement with infiltration beds, dry wells, infiltration trenches, surface and sub-surface infiltration basins. All infiltration activities should be coordinated with the groundwater management agencies, such as the Orange County Water District); (2) Harvesting and Re-use (e.g., cisterns and rain barrels); and (3) Bio-treatment such as bio-filtration/bio-retention.*

To our knowledge, no one has objected to Section XII.C.4 during the public comment periods on the permit. The Fourth Draft permit would create an end-run around this key aspect of the negotiation process.

- Narrow LID is inconsistent with U.S. EPA guidance which promotes filtration and biotreatment as part of LID. Of five U.S. EPA sources regarding LID, four included biotreatment-type terms, such as detention (i.e., slow down, treat, then release), filtration, and surface release of stormwater. In a compilation of case studies by U.S. EPA, most of 17 exemplary projects included biotreatment elements, such as bioretention, swales, wetlands, and green roofs. *See* U.S. EPA 841-F-07-006, discussed in the May 8 submittal from Mr. Eric Strecker, Geosyntec, (Attachment C). Each of two case studies described in another EPA document, s*ee* EPA 841-B-00-005, included the use of under-drains, and one of them specifically fed into the main storm drain system. A U.S. EPA document updated in January 2009 references additional resources, one of which refers to the many practices used to adhere to LID principles of promoting a watershed's hydrologic and ecological functions, such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. *See* EPA-560-F-07-231. A fact sheet used in conjunction with that document describes under-drains used to release treated stormwater off site, permitting planted areas to safely allow filtration of stormwater. The embrace by U.S. EPA Region 9 staff of the NRDC approach is inconsistent with the weight of the agency's pronouncements regarding LID.

- The Fourth Draft is inconsistent with SWRCB guidance. SWRCB identifies LID as a sustainable practice that benefits water supply and contributes to water quality protection, stating that, "The goal of LID is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of rainfall" (emphasis added). SWRCB also states that, "LID practices include; bioretention facilities or rain gardens, grass swales and channels, vegetated rooftops, rain barrels, cisterns, vegetated filter strips, and permeable pavements" (emphasis added). As can be seen, SWRCB defines LID as including filtration, detention, and bioretention, and

other practices, each of which produce runoff and would not be part of the LID standard under the Fourth Draft. In addition, SWRCB characterizes mimicking pre-development hydrology as a "goal," not an enforceable standard, which is consistent with the change in Section XII.C.3 directed by the Board on April 24, and not implemented in the Fourth Draft. *Found at*: http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/.

- Narrow LID does not achieve superior water quality. Biotreatment BMPs including natural treatment systems such as those that are part of the IRWD's Natural Treatment System can remove vast quantities of pollutant load, and provide other benefits such as habitat, flood control, and aesthetic, recreational and educational value. To relegate multi-benefit biotreatment BMPs to a status inferior to on-site retention BMPs is not justified on a water quality basis, and is bad public policy, essentially depriving the region of an extremely important and effective approach to managing water quality. Sinking water can have adverse consequences such as altering the natural flow regime of the receiving waters, depriving riparian corridors of base and storm flows, mobilizing pre-existing contamination in shallow groundwater, and causing damage from rising groundwater, etc. In addition, the Fourth Draft does not even limit infiltration BMPs to those that are "properly engineered and maintained" (which it does for biotreatment BMPs), and infiltration BMPs are prone to clogging and other maintenance problems that can reduce effectiveness. The use of infiltration, harvesting of rainwater, and evapotranspiration alone or in combination is not necessarily better from a water quality perspective, and can be less effective than biotreatment, as shown by Mr. Eric Strecker at the April 24 hearing and in the submittals from Geosyntec.

- Narrowing the use of LID to that which excludes biotreatment is not consistent with the MEP standard. Consistency with the MEP standard implies that project proponents should be provided a slate of BMP options which is robust enough to permit implementation and achieve water quality benefits in a wide variety of contexts. Therefore, consistency with the MEP standard should rule out any uncritical approach that insists upon BMPs that are neither implementable nor desirable to manage the entire design storm volume in the vast majority of cases. A narrow prescription of LID without biotreatment is such an uncritical approach, which may have superficial appeal, but is not consistent with the MEP standard and does not reflect any serious policy consideration.

- Region 9 staff's recent advocacy for NRDC's narrow LID is inconsistent with Region 9's prior positions. Region 9 told counsel for CICWQ that its main concern was to make sure conventional BMPs would not be elevated to LID status. Staff also stated that U.S. EPA was not opposed to the Regional Board using biotreatment as a LID option, which would be a position completely consistent with U.S. EPA policy. Now, the Region 9 staff are advocating for NRDC's retention standard that allows biotreatment only in cases of infeasibility as determined by yet-to-be-specified criteria. This new position is inconsistent with the Region 9's prior position, and shows clear advocacy for NRDC's narrow view of LID, rather than U.S. EPA's policy on LID.

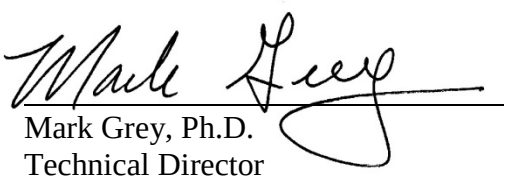
II. REQUESTED ACTIONS

We request that the Regional Board adopt the attached redline version of Section XII.C of the Draft Permit, which is consistent with the Regional Board's April 24 direction as well as with U.S. EPA and SWRCB policy and the stakeholder negotiations.

We further note that, if NRDC or any other party seeks to cross-examine or otherwise examine staff or any party, CICWQ and the Building Industry Legal Defense Foundation (BILD) would want the same opportunity. Accordingly, we respectfully request that the Regional Board recognize CICWQ and BILD as designated parties.

If you have any questions or want to discuss the content of our comment letter, please feel free to contact me at (909) 396-9993, ext. 252, (909) 525-0623, cell phone, or mgrey@biasc.org.

Respectfully,



Mark Grey, Ph.D.
Technical Director
Construction Industry Coalition on Water Quality

Description of Attachments:

Attachment A – Regulated Community Proposal (May 7, 2009), for Section XII.C
Attachment B – Rationale for Regulated Community Proposal (May 7, 2009)
Attachment C – EPA Definitions of and Guidance on Low Impact Development

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Memorandum

Date:	May 7, 2009
To:	Construction Industry Coalition on Water Quality, Mark Grey, Ph.D.
cc:	Michael Adackapara David Rice
From:	Eric Strecker, P.E., and Nicole Dunn, Geosyntec Consultants
Subject:	Tentative Order No. R8-2009-0030: EPA Definitions of and Guidance on Low Impact Development (LID)

BACKGROUND AND PURPOSE

There are multiple definitions of Low Impact Development that EPA has used in their documents. The National Resources Defense Council (NRDC) cited a definition to support their position that runoff from storms up to the water quality design storm be retained on site (or not allowed to surface discharge in reality). The purpose of this memo is to identify the various definitions of LID that EPA has included in guidance documents that they either prepared or participated in producing. In addition to the definition, the actual guidance has been reviewed to see if the guidance supports the definition of LID or whether in fact that biotreatment (or biofiltration) and surface discharge is in fact part of the guidance or case studies included. Finally, some additional recommendations are made regarding the state of analysis and evaluation of the practicality and results of retention requirements.

DEFINITIONS OF AND GUIDANCE REGARDING LID

In review of EPAs web site and related documents, the following EPA Reports or referenced reports include definitions of LID:

1. *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, December 2007 (EPA 841-F-07-006).* (Cited by NRDC in April 24th Hearing) http://www.epa.gov/owow/nps/lid/costs07/documents/reducingstormwatercosts.pdf
2. *Low Impact Development (LID) Literature Review, October 2000 (EPA-841-B-00-005). http://www.epa.gov/owow/nps/lid/lid.pdf*
3. *Low-Impact Development: An Integrated Environmental Design Approach (This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA), June 1999.* http://www.epa.gov/owow/nps/lid/lidnatl.pdf

4. *Polluted Runoff (Nonpoint Source Pollution) Low Impact Development (LID), Last updated on Thursday, January 15th, 2009* http://www.epa.gov/owow/nps/lid/ *Additional information from linked factsheet: Design Principles for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas, April 2008 (EPA-560-F-07-231)* http://www.epa.gov/brownfields/publications/swdp0408.pdf
5. *Low Impact Development (LID) and Other Green Design Strategies, Last updated on October 09, 2008* http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=124

Table 1 (at end of document) includes the definition of LID that each of these EPA or EPA referenced documents as well as information on the guidance that is included in the document that addresses whether some form of detention, filtration, and surface release of stormwater is included. Table 2 summarizes in brief form whether the definition of each document reference includes detention, filtration and stormwater release (or equivalent) in the definition and the guidance.

Table 2. Summary of Filtration and Surface Release Inclusion in LID Definitions and associated guidance.

Document/Reference	**Filtration and Surface Release**	
	In Definition	**In Guidance/ Examples**
Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, December 2007 (EPA 841-F-07-006)	No	Yes
Low Impact Development (LID) Literature Review, October 2000 (EPA-841-B-00-005	Yes	Yes
Low-Impact Development: An Integrated Environmental Design Approach (This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA), June 1999	Yes	Yes
Polluted Runoff (Nonpoint Source Pollution) Low Impact Development (LID), Last updated on Thursday, January 15th, 2009 *Additional information from linked factsheet: Design Principles for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas, April 2008 (EPA-560-F-07-231)*	Not Clear	Yes
Low Impact Development (LID) and Other Green Design Strategies, Last updated on October 09, 2008h	No	Not Clear

Table 2 clearly indicates that EPA has not been and continues not to be consistent in its definition of LID on whether it includes detention, filtration (biofiltration), and release of stormwater. Some of the definitions appear to be clear one way or the other, while one is not clear. In the guidance document or other materials that are associated with a particular definition almost all include some form of detention, filtration and surface release of stormwater.

It should be noted that in EPAs definitions, they interpret infiltration as "managing on site" where in fact in many cases infiltrated waters would be expected to reach a surface water body after either shallow interflow or deeper infiltration and downstream reappearance (after filtering thru soils and obvious detention). In the definitions, EPA is clearly focused on surface hydrology, when in fact hydrology includes groundwater hydrology.

Review of Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, December 2007 (EPA 841-F-07-006)

This document merits some additional discussion, as it has been cited as showing the retention on site is feasible. In this document, Biotreatment of one form (i.e., bioretention, swales, wetland, green roofs) is presented in most of the 17 cases studies referenced. However, the document does not in most cases clearly indentify whether or not underdrains were included in these features. The Table below highlights the biotreatment elements that were included in the 17 case studies.

LID Technique	Number of case studies
Bioretention	12*
Swales	12*
Wetlands	6
Green roofs	1

* use of underdrains not indicated

Note that green roofs would have some form of underdrain or overflow and therefore would release stormwater similar to a biorention system with underdrains. Most swales also discharge well before the design storm volume has been introduced; in a few cases in the document they have been observed to infiltrate large volume of runoff. Finally, wetlands are clearly not features that retain on site up to the design storm. They either act as extended detention systems with a wet pool or a wet pond with releases during the storm event. Therefore, it is clear that this document includes biotreatment features (include regional like features – wetlands) that are identified by EPA as part cost-effective examples of LID. It is likely that some of the biorention systems may also include underdrains, but this was not provided in the guidance. Attachment 1 provides additional citations from the document that clearly show that detention/conveyance type LID features were included.

This document, while presenting some example projects that are useful, does not provide enough detail to support or not support universal on-site retention of stormwater. There are no

evaluations of projects with cisterns, including cost effectiveness. Finally, there is very little information on the overall performance of the systems, either from monitoring data or modeling.

SUMMARY

There are multiple definitions in EPA and EPA cited reports that do and do not include biotreatment-like LID features (detention/biofiltration/biotreatment and release). EPA is not consistent in their definition of LID. Second, the associated guidance with each of the definitions in almost all cases includes LID features that clearly are biofiltration/detention and surface release.

It is clear that the issue of requiring retention on site has not been systematically or technically evaluated. To date, the information has been very anecdotal with a few examples cited. Even with the examples, very little information is provided. The issue of the feasibility of "retention on site" standards needs to be evaluated on a national scale as well as locally.

Table 1. EPA Definitions of LID in EPA or EPA Referenced Documents and Guidance Elements that Include Treatment and Surface Release.

Source #	EPA or EPA Listed Document	LID definition directly from document	Additional Information
1.	*Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, December 2007 (EPA 841-F-07-006)*[i]	LID comprises a set of approaches and practices that are designed to reduce runoff of water and pollutants from the site at which they are generated. By means of ***infiltration, evapotranspiration, and reuse of rainwater***, LID techniques manage water and water pollutants at the source and thereby prevent or reduce the impact of development on rivers, streams, lakes, coastal waters, and ground water.	The document notes that, "The costs might be higher because of the costs of plant material, site preparation, soil amendments, ***underdrains and connections to municipal stormwater systems***, and increased project management." NOTE: See ATTACHMENT 1 also for additional information

Source #	EPA or EPA Listed Document	LID definition directly from document	Additional Information
2.	*Low Impact Development (LID) Literature Review, October 2000 (EPA-841-B-00-005)*[ii]	LID is a site design strategy with a goal of maintaining or replicating the predevelopment hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic landscape. 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, and the lengthening of flow paths and runoff time (Coffman, 2000). Other 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 principles are based on controlling stormwater at the source by the use of microscale controls that are distributed throughout the site.	Two case studies shown include the use of underdrains: • Bioretention Facility Laboratory and Field Study Beltway Plaza Mall Parking Lot, Greenbelt, MD, "The depth of the system is 42" and is designed so that runoff infiltrates through the system and ***is collected by a 6-inch diameter perforated pipe underdrain, which feeds into the main storm drain system***." • Vegetated Roof Cover, Philadelphia, PA, "***Synthetic under-drain layer*** that promotes rapid drainage of water from the surface of the roof deck"

Source #	EPA or EPA Listed Document	LID definition directly from document	Additional Information
3.	*Low-Impact Development: An Integrated Environmental Design Approach (This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA), June 1999*[iii]	The primary goal of Low Impact Development methods is to mimic the predevelopment site hydrology by using site design techniques that ***store, infiltrate, evaporate, and detain runoff***. Use of these techniques helps to reduce off-site runoff and ensure adequate groundwater recharge.	The document notes that, "The use of micromanagement practices, as well as ***the use of underdrains*** to provide positive subdrainage for bioretention practices, helps to overcome many of the traditional soil limitations for the selection and use of IMPs."

Source #	EPA or EPA Listed Document	LID definition directly from document	Additional Information
4.	*Polluted Runoff (Nonpoint Source Pollution) Low Impact Development (LID), Last updated on Thursday, January 15th, 2009*[iv] *Additional information from linked factsheet: Design Principles for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas, April 2008 (EPA-560-F-07-231)*[v]	LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions.	The document notes that, "There are many practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements." The definition is from a website, which contains links to a variety of fact sheets and reports, design/guidance manuals, and information resources and centers. One of the factsheets, "Design Principles for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas," discusses how buildings and other impervious surfaces can be strategically located to act as caps over contaminated areas and states, "Areas with fill caps can include soils and vegetation above the cap in the form of swales or rain gardens. If fitted with ***an under-drain system*** to release treated stormwater off site, these planted areas can safely allow filtration and evapotranspiration of stormwater. Additional features like impermeable liners or gravel filter blankets can be coupled with modified low impact development (LID) practices that safely filter stormwater without exposing the water to contaminated soils."

Source #	EPA or EPA Listed Document	LID definition directly from document	Additional Information
5.	*Low Impact Development (LID) and Other Green Design Strategies, Last updated on October 09, 2008*[vi]	Like other alternative development strategies, LID seeks to control stormwater at its source. Rather than moving stormwater offsite though a conveyance system, the goal of LID is to restore the natural, pre-developed ability of an urban site to absorb stormwater. LID integrates small-scale measures scattered throughout the development site. Constructed green spaces, native landscaping, and ***a variety of innovative bioretention and infiltration techniques capture and manage stormwater on-site***. LID reduces peak runoff by allowing rainwater to ***soak into the ground, evaporate into the air, or collect in storage receptacles*** for irrigation and other beneficial uses.	While, the definition appears to states that LID techniques capture and manage stormwater on-site, thereby implying LID techniques only include retention and not detention, the document also states that, "In areas with slow drainage or infiltration, LID captures the first flush ***before excess stormwater is diverted into traditional storm conveyance systems***. The result is development that more closely maintains pre-development hydrology. Furthermore, LID has been shown to be cost effective, and in some cases, cheaper than using traditional stormwater management techniques."

Attachment 1. Selected Statements in Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, December 2007 (EPA 841-F-07-006)

"For example, in lieu of a treatment pond serving a new subdivision, planners might incorporate a bioretention area in each yard, disconnect downspouts from driveway surfaces, remove curbs, and install grassed swales in common areas. Integrating small practices throughout a site instead of using extended detention wet ponds to control runoff from a subdivision is the basis of the LID approach." p. 2

NOTE: Grassed swales are typically thought of as biofiltration with some, but usually limited infiltration

"***Runoff conveyance practices.*** Large storm events can make it difficult to retain all the runoff generated on-site by using infiltration and storage practices. In these situations, conveyance systems are typically used to route excess runoff through and off the site. In LID designs, conveyance systems can be used to slow flow velocities, lengthen the runoff time of concentration, and delay peak flows that are discharged off-site. LID conveyance practices can be used as an alternative to curb-and-gutter systems, and from a water quality perspective they have advantages over conventional approaches designed to rapidly convey runoff off-site and alleviate on-site flooding. LID conveyance practices often have rough surfaces, which slow runoff and increase evaporation and settling of solids. They are typically permeable and vegetated, which promotes infiltration, filtration, and some biological uptake of pollutants. LID conveyance practices also can perform functions similar to those of conventional curbs, channels, and gutters. For example, they can be used to reduce flooding around structures by routing runoff to landscaped areas for treatment, infiltration, and evapotranspiration.
Filtration practices are used to treat runoff by filtering it through media that are designed to capture pollutants through the processes of physical filtration of solids and/or cation exchange of dissolved pollutants. Filtration practices offer many of the same benefits as infiltration, such as reductions in the volume of runoff transported offsite, ground water recharge, increased stream baseflow, and reductions in thermal impacts to receiving waters. Filtration practices also have the added advantage of providing increased pollutant removal benefits. Although pollutant build-up and removal may be of concern, pollutants are typically captured in the upper soil horizon and can be removed by replacing the topsoil." p. 4-5

Note: This description clearly includes biotreatment LID features that includes filtration and surface conveyance of runoff.

". . . bioretention areas and swales can be incorporated into the landscaping of yards, in rights of-way along roadsides, and in or adjacent to parking lots." p. 9-10

Note: Swales again are practices that typically convey and filter runoff with some infiltration and ET benefits

"**2ND AVENUE SEA STREET, SEATTLE, WASHINGTON**
The design reduced imperviousness, included retrofits of bioswales to treat and manage stormwater, and added 100 evergreen trees and 1,100 shrubs.14 Conventional curbs and gutters

were replaced with bioswales in the rights-of-way on both sides of the street. . . . Hydrologic monitoring of the project indicates a 99 percent reduction in total potential surface runoff, and runoff has not been recorded at the site since December 2002, a period that included the highest-ever 24-hour recorded rainfall at Seattle-Tacoma Airport.16" p. 12-13

Note: Although this design is referred to as Bioswales, the size, depth, etc. of these systems make them more bioretention facilities than swales. Also note that at this site, it is likely that infiltration levels are fair above natural.

"**AUBURN HILLS SUBDIVISION, SOUTHWESTERN WISCONSIN**
Auburn Hills in southwestern Wisconsin is a residential subdivision developed with conservation design principles. Forty percent of the site is preserved as open space; this open space includes wetlands, green space and natural plantings, and walking trails. The subdivision was designed to include open swales and bioretention for stormwater management. . . . Stormwater savings were realized primarily through the use of vegetated swales and bioswales. These LID practices provided stormwater conveyance and treatment and also lowered the cost of conventional stormwater infrastructure." p. 13

Note: Conveyance swales were included that provided conveyance and treatment

"**BELLINGHAM, WASHINGTON, PARKING LOT RETROFITS**
The City of Bellingham, Washington, retrofitted two parking lots . . . with rain gardens in lieu of installing underground vaults to manage stormwater. . . . Flows were directed to the rain gardens by curbs. An overflow system was installed to accommodate higher flows during heavy rains." p. 14

Note: Higher flows not identified, but may or may not actually retain the water quality design storm.

"**CENTRAL PARK COMMERCIAL REDESIGNS, FREDERICKSBURG, VA (A MODELING STUDY)**
The Friends of the Rappahannock undertook a cost analysis involving the redesign of site plans for several stores in a large commercial development in the Fredericksburg, Virginia, area called Central
Park.23,24 Table 6 contains a side-by-side analysis of the cost additions and reductions for each site for scenarios where LID practices (bioretention areas and swales) were incorporated into the

existing, traditional site designs.

Table 6. Site Information and Cost Additions/Reductions Using LID Versus Traditional Designs

Name	Total BMP Area (ft^2)	Total Impervious Area Treated (ft^2)	Percent of Impervious Area Treated	Cost Additions[a]	Cost Reductions[b]	Change in Cost After Redesign
Breezewood Station Alternative 1	4,800	64,165	98.4%	$36,696	$34,785	+ $1,911
Breezewood Station Alternative 2	3,500	38,775	59.5%	$24,449	$21,060	+ $3,389
Olive Garden	1,780	31,900	59.1%	$14,885	$11,065	+ $3,790
Kohl's, Best Buy, & Office Depot	14,400	354,238	56.3%	$89,433	$80,380	+ $9,053
First Virginia Bank	1,310	20,994	97.7%	$6,777	$1,148	+ $5,629
Chick-Fil-A[c]	1,326	28,908	82.2%	$6,846	$12,540	– $5,694

[a] Additional costs for curb, curb blocks, storm piping, inlets, underdrains, soil, mulch, and vegetation as a result of the redesign.
[b] Reduced cost for curb, storm piping, roof drain piping, and inlets as a result of the redesign.
[c] Cost reduction value includes the cost of a Stormceptor unit that is not needed as part of the redesign. "

p. 15 **Note:** Table 6 shows cost comparison of LID vs. Traditional designs and the cost additions column includes additional costs for underdrains, etc.

NOTE: Swales included

"**CROWN STREET, VANCOUVER, BRITISH COLUMBIA**
. . . the City relocated stormwater catch basins that would have been enclosed within the extended curb. Now, at certain intersections, the City uses the new space behind the curb to install "infiltration bulges" to collect and infiltrate roadway runoff. The infiltration bulges are constructed of permeable soils and vegetation. (The City of Portland, Oregon, has installed similar systems, which they call "vegetated curb extensions.") The catch basins are left in place, and any stormwater that does not infiltrate into the soil overflows into the storm drain system.33" p. 15

Note: These are retrofit systems and include overflows. Information not available on at what level they overflow.

"**GARDEN VALLEY, PIERCE COUNTY, WASHINGTON (A MODELING STUDY)**
The Garden Valley subdivision is a 9.7-acre site in Pierce County, Washington. A large wetland on the eastern portion of the site and a 100-foot buffer account for 43 percent of the site area. Designers evaluated a scenario in which roadway widths were reduced and conventional stormwater management practices were replaced with swales, bioretention, and soil amendments…The LID practices were expected to increase infiltration and reduce stormwater discharge rates, which can improve the health and quality of receiving streams." p. 17

Note: Not a real site. Included swale conveyance systems.

"KENSINGTON ESTATES, PIERCE COUNTY, WASHINGTON (A MODELING STUDY)
A study was undertaken to evaluate the use of LID techniques at the Kensington Estates subdivision,

a proposed 24-acre development consisting of single-family homes on 103 lots. The study assumed that conventional stormwater management practices would be replaced entirely by LID techniques, including reduced imperviousness, soil amendments, and bioretention areas. . . . Three wetlands and an open space tract would treat stormwater discharging from LID installations. Open space buffers were included in the design. The LID proposal also included rooftop rainwater collection systems on each house.40,41" p. 18

NOTE: Included bioretention systems and then treatment of overflow in wetlands. Not clear at what storm size overflow occurs.

"**LAUREL SPRINGS SUBDIVISION, JACKSON, WISCONSIN**
Vegetated swales and bioswales largely were used to replace conventional stormwater infrastructure and led to significant savings. Each of these factors helped to contribute to a more hydrologically functional site that reduced the total amount of stormwater volume and managed stormwater through natural processes." p. 19

Note: Swales that conveyed runoff included.

"**MILL CREEK SUBDIVISION, KANE COUNTY, ILLINOIS**
The designers used open swales as the primary means for stormwater conveyance. Coupled with other site techniques to reduce runoff volumes and discharge rates, significant savings in stormwater construction were avoided because of reduced storm sewer installation; sump pump connections; trench backfill; and catch basin, inlet, and cleanout installation." p. 20

Note: Swales that conveyed runoff included

"**POPLAR STREET APARTMENTS, ABERDEEN, NORTH CAROLINA**
The use of bioretention, topographical depressions, grass channels, swales, and stormwater basins at the 270-unit Poplar Street Apartment complex improved stormwater treatment and lowered construction costs. The design allowed almost all conventional underground storm drains to be eliminated from the design. The design features created longer flow paths, reduced runoff volume, and
filtered pollutants from runoff." p. 21

Note: Grass channels and swales included to treat (filter) and convey surface runoff

"**PRAIRIE CROSSING SUBDIVISION, GRAYSLAKE, ILLINOIS**
The Prairie Crossing subdivision is a conservation development on 678 acres, of which 470 acres is open space. The site was developed as a mixed-use community with 362 residential units and 73 acres of commercial property, along with schools, a community center, biking trails, a lakefront beach, and a farm. The site uses bioretention cells and vegetated swales to manage stormwater…The use of alternative street edges, vegetated swales, and bioretention and the preservation of natural areas all reduced the need for and cost of conventional stormwater infrastructure." p. 22

Note: Swales that treat and convey included

"**PRAIRIE GLEN SUBDIVISION, GERMANTOWN, WISCONSIN**
The Prairie Glen subdivision is nationally recognized for its conservation design approach. A significant portion of the site (59 percent) was preserved as open space. Wetlands were constructed to manage stormwater runoff, and the open space allowed the reintroduction of native plants and wildlife habitat. The site layout incorporated hiking trails, which were designed to allow the residents to have easy access to natural areas.54…The use of open-channel drainage and bioretention minimized the need for conventional stormwater infrastructure and accounted for the bulk of the savings in stormwater management." p. 23

Note: Wetlands used to treat runoff; open channel drainage included in LID description

SOMERSET SUBDIVISION, PRINCE GEORGE'S COUNTY, MARYLAND
The Somerset subdivision, outside Washington, D.C., is an 80-acre site consisting of nearly 200 homes. Approximately half of the development was built using LID techniques; the other half was conventionally built using curb-and-gutter design with detention ponds for stormwater management. Bioretention cells and vegetated swales were used in the LID portion of the site to replace conventional stormwater infrastructure." p. 24

Note: Vegetated swales to treat and convey runoff included

"**TELLABS CORPORATE CAMPUS, NAPERVILLE, ILLINOIS**
Development of the site included preserving trees and some of the site's natural features and topography. For stormwater management, the site uses bioswales, as well as other infiltration techniques, in parking lots and other locations." p. 25

Note: Bioswales included

TORONTO GREEN ROOFS, TORONTO, ONTARIO (A MODELING STUDY)
Toronto is home to more than 100 green roofs. To evaluate the benefits of greatly expanded use of green roofs in the city, a study was conducted using a geographic information system to model the effects of installing green roofs on all flat roofs larger than 3,750 square feet. (The model assumed that each green roof would cover at least 75 percent of the roof area.) If the modeling scenario were implemented, 12,000 acres of green roofs (8 percent of the City's land area) would be installed.63 The study quantified five primary benefits from introducing the green roofs: (1) reduced stormwater flows into the separate storm sewer system, (2) reduced stormwater flows into the combined sewer system,
(3) improved air quality, (4) mitigation of urban heat island effects, and (5) reduced energy consumption.64

NOTE: Green roofs do not retain significant volumes of runoff during extended wet periods.

[i] http://www.epa.gov/owow/nps/lid/costs07/documents/reducingstormwatercosts.pdf
[ii] http://www.epa.gov/owow/nps/lid/lid.pdf
[iii] http://www.epa.gov/owow/nps/lid/lidnatl.pdf
[iv] http://www.epa.gov/owow/nps/lid/
[v] http://www.epa.gov/brownfields/publications/swdp0408.pdf
[vi] http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=124

ATTACHMENT B – GUIDE TO PROPOSED REVISIONS TO SECTION XII.C

This attachment is a guide to the basis for the proposed changes to Section XII.C, reflected in Attachment A:

- In Section XII.C.1, the feasibility criteria language was removed likely because of U.S. EPA's concern that projects that are developed before the feasibility criteria get established would not be required to implement LID principles described in Section XII.C. However, U.S. EPA's concern with timing was not addressed by its proposed revision to C.1 of removing the feasibility criteria. The following clause, "As provided in Section XII.J, 90 days after approval of the revised model WQMP," was added to clarify that the timing of LID implementation is contingent upon approval of the revised model WQMP. The following sentence was also added to the end of Section XII.C.1, "To the extent the Executive Officer has not approved feasibility criteria as provided in Section XII.E.1, the feasibility of implementing LID BMPs shall be determined through a project-specific feasibility analysis submitted to the Executive Officer for approval." This is done in order to address that until feasibility criteria are established and approved, the feasibility of LID implementation will be made on a project-by-project basis.

- In Section XII.C.2, "bio-filter" is replaced with the word "biotreat" so as to be consistent with the remaining references of the word treat throughout Section C.

- In Section XII.C.2, "conventional" is replaced with "similarly effective" in referencing treatment control BMPs so as to eliminate the inference that low common denominator BMPs would be sufficient. Rather, similarly effective BMPs to be used means BMPs that generally are as effective as LID BMPs.

- In Section XII.C.2, Footnotes 56 and 57 each were amended to read, "A properly engineered and maintained bio-filtration, bio-retention or other bio-treatment systems may be considered only in accordance with the priorities specified in Section XII.C.4." Limiting the use of biotreatment to only where infiltration, harvesting and reuse, and evapotranspiration are not feasible is inconsistent with the priority scheme worked out during the stakeholder negotiations, where it was agreed that a tiered approach would be used and biotreatment was among the basket of options. Further, it is inconsistent with Section XII.C.4., which prioritizes LID principles, but includes biotreatment as an option.

- In Section XII.C.2, the sentence suggested by U.S. EPA, "Projects that do not comply with this requirement shall meet the requirements established in section XII.E. for alternative or in-lieu compliance," is moved from the middle of the paragraph to the near end of the paragraph so that similarly effective treatment control BMPs as described in Section XII.C.7 would still be an option as a second tier of LID before having to resort to alternative or in-lieu compliance for projects that cannot implement similarly effective BMPs.

- In Section XII.C.3, the word "strategy" is replaced with the word "goal" to implement the direction that Regional Board gave staff.

- In Section XII.C.7, "evapotranspire," "capture," and "biotreat" are added for consistency because those LID options appear absent in a few instances in this section.

NOTE: RB changes from Third to Fourth Draft in blue. Regulated community changes to Fourth Draft in red.

C. LOW IMPACT DEVELOPMENT TO CONTROL POLLUTANTS IN URBAN RUNOFF FROM NEW DEVELOPMENT/SIGNIFICANT REDEVELOPMENT:

1. Within 12 months of adoption of this order, the permittees shall update the model WQMP to incorporate LID principles (as per Section XII.C) and to address the impact of urbanization on downstream hydrology (as per Section XII.D) and a copy of the updated WQMP shall be submitted for review and approval by the Executive Officer[55]. As provided in Section XII.J, 90 days after approval of the revised model WQMP, p~~P~~riority development projects ~~that meet the feasibility criteria established pursuant to Section XII.E~~ shall implement the LID principles described in this section, Section XII.C. To the extent the Executive Officer has not approved feasibility criteria as provided in Section XII.E.1, any infeasibility of implementing LID BMPs shall be determined through a project-specific analysis submitted to the Executive Officer for approval.

2. The permittees shall reflect in the WQMP and otherwise require that each priority development project infiltrate, harvest and re-use, evapotranspire, ~~ or~~ capture, or bio-~~filter~~treat[56] the 85th percentile storm event ("design capture volume"), as specified in Section XII.B.4.A.1, above. ~~Projects that do not comply with this requirement shall meet the requirements established in section XII.E. for alternative or in-lieu compliance.~~ Any portion of ~~this~~ the design capture volume that is not infiltrated, harvested and re-used, evapotranspired, ~~ or~~ captured or bio-~~filtered~~treated[57] onsite by LID BMPs shall be treated and discharged using LID or ~~conventional~~ similarly effective treatment control BMPs or mitigated as set forth in Section XII.C.7, below. Projects that do not comply with this requirement shall meet the requirements established in Section XII.E. for alternative or in-lieu compliance.

3. The permittees shall incorporate LID site design principles to reduce runoff to a level consistent with the maximum extent practicable standard during each phase of priority development projects. The permittees shall require that each priority development project include site design BMPs during development of the preliminary and final WQMPs. The design ~~strategy~~ goal shall be to maintain or replicate the pre-development hydrologic regime through the use of design techniques that create a functionally equivalent post-development hydrologic regime through site preservation techniques and the use of integrated and distributed micro-scale storm water infiltration, retention, detention,

[55] The Executive Officer shall provide members of the public with notice and at least a 30-day comment opportunity for all documents submitted in accordance with this order. If the Executive Officer, after considering timely submitted comments, concludes that the document is adequate or adequate with specified changes, the Executive Officer may approve the document or present it to the Board for its consideration at a regularly scheduled and noticed meeting.

[56] A properly engineered and maintained bio-filtration, bio-retention or other bio-treatment systems may be considered only ~~if infiltration, harvesting and reuse and evapotranspiration are not feasible~~ in accordance with the priorities specified in Section XII.C.4.

[57] A properly engineered and maintained bio-filtration, bio-retention or other bio-treatment systems may be considered only ~~if infiltration, harvesting and reuse and evapotranspiration are not feasible~~ in accordance with the priorities specified in Section XII.C.4.

evapotranspiration, filtration and treatment systems as close as feasible to the source of runoff. Site design considerations shall include, but not be limited to:

a. Limit disturbance of natural water bodies and drainage systems; conserve natural areas; preserve trees; minimize compaction of highly permeable soils; protect slopes and channels; and minimize impacts from storm water and urban runoff on the biological integrity of natural drainage systems and water bodies;

b. Minimize changes in hydrology and pollutant loading; require incorporation of controls, including structural and non-structural BMPs, to mitigate the projected increases in pollutant loads and flows; ensure that post-development runoff durations and volumes from a site have no significant adverse impact on downstream erosion and stream habitat; minimize the quantity of storm water directed to impermeable surfaces and the MS4s; minimize paving, minimize runoff by disconnecting roof leader and other impervious areas and directing the runoff to pervious and/or landscaped areas, minimize directly connected impervious areas; design impervious areas to drain to pervious areas; consider construction of parking lots, walkways, etc., with permeable materials; minimize pipes, culverts and engineered systems for storm water conveyance thereby minimizing changes to time of concentration on site; utilize rain barrels and cisterns to collect and re-use rainwater; maximize the use of rain gardens and sidewalk storage; and maximize the percentage of permeable surfaces distributed throughout the site's landscape to allow more percolation of storm water into the ground;

c. Preserve wetlands, riparian corridors, vegetated buffer zones and establish reasonable limits on the clearing of vegetation from the project site;

d. Use properly designed and well maintained water quality wetlands, bio-retention areas, filter strips and bio-filtration swales; consider replacing curbs gutters and conventional storm water conveyance systems with biotreatment systems, where such measures are likely to be effective and technically and economically feasible;

e. Provide for appropriate permanent measures to reduce storm water pollutant loads in storm water from the development site;

f. Establish development guidelines for areas particularly susceptible to erosion and sediment loss;

g. Implement effective education programs to educate property owners to use pollution prevention measures and to maintain on-site hydrologically functional landscape controls; and

h. During the early planning stages of a project, the LID principles shall be considered to address pollutants of concern identified in the Watershed Action Plans and TMDL Implementation Plans, and the LID BMPs shall be incorporated into the sites conceptual WQMP.

4. The selection of LID principles shall be prioritized in the following manner (from highest to the lowest priority): (1) Preventative measures (these are mostly non-

structural measures, e.g., preservation of natural features to a level consistent with the maximum extent practicable standard; minimization of runoff through clustering, reducing impervious areas, etc.) and (2) Mitigation (these are structural measures, such as, infiltration, harvesting and reuse, bio-treatment, etc. The mitigation or structural site design BMPs shall also be prioritized (from highest to lowest priority): (1) Infiltration (examples include permeable pavement with infiltration beds, dry wells, infiltration trenches, surface and sub-surface infiltration basins. All infiltration activities should be coordinated with the groundwater management agencies, such as the Orange County Water District); (2) Harvesting and Re-use (e.g., cisterns and rain barrels); and (3) Bio-treatment such as bio-filtration/bio-retention.

5. Even though the LID principles are universally applicable, there could be constraining factors, such as: soil conditions, including soil compaction, saturation (e.g., hydric soils) and permeability, groundwater levels, soil contaminants (Brownfield developments), space restrictions (in-fill projects, redevelopment projects, high density development, transit-oriented developments), naturally occurring contaminants (e.g., selenium in the soil and the groundwater in the Newport Bay Watershed), etc. In such cases, the LID principles could be integrated into other programs, such as: Smart Growth[58], New Urbanism[59] or regional or sub-watershed management approaches. Also see Section E, below, for alternatives and in-lieu programs.
6. The LID BMPs shall be designed to mimic pre-development site hydrology through technically and economically feasible preventive and mitigative site design techniques. LID combines hydrologically functional site design with pollution prevention methods to compensate for land development impact on hydrology and water quality.
7. If site conditions do not permit infiltration, harvesting and re-use, ~~and/or~~ evapotranspiration, capture, and/or biotreatment of the design capture volume at the project site as close to the source as possible, the alternatives discussed below should be considered and the credits and in-lieu programs discussed under Section E, below, may be considered:
    a. Implement LID principles at the project site. This is the preferred approach. For example, in a single family residential development: connect roof drains to a landscaped area, divert driveway runoff to a vegetated strip and minimize any excess runoff generated from the development. The pervious areas to which the runoff from the impervious areas are connected should have the capacity to infiltrate, ~~and/or~~ harvest and re-use, evapotranspire, capture, or treat at least the design capture volume.

[58] Smart Growth refers to the use of creative strategies to develop ways that preserve natural lands and critical environmental areas, protect water and air quality, and reuse already-developed land.

[59] New Urbanism is somewhat similar to Smart Growth and is based on principles of planning and architecture that work together to create human-scale, walkable communities that preserve natural resources.

b. Implement as many LID principles as possible at the project site close to the point of storm water generation and infiltrate, ~~and/or~~ harvest and re-use, evapotranspire, capture, or biotreat at least the design capture volume through designated ~~infiltration/treatment~~ areas elsewhere within the project site. For example, at a condominium development: connect the roof drains to landscaped areas, construct common parking areas with pervious asphalt with a sub-base of rocks or other materials to facilitate percolation of storm water, direct road runoff to curbless, vegetated sidewalks. The pervious areas which receive runoff from impervious areas should have the capacity to infiltrate, harvest and re-use, evapotranspire, capture, or treat at least the design capture volume.

c. Implement LID on a sub-regional basis. For example, at a 100 unit high density housing unit with a small strip mall and a school: connect all roof drains to vegetated areas (if there are any vegetated areas, otherwise storm water storage and reuse may be considered or else divert to the local storm water conveyance system, to be conveyed to the local treatment system), construct a storm water infiltration gallery below the school playground to infiltrate and/or harvest and re-use the design capture volume. The pervious areas to which the runoff from the impervious areas are connected should have the capacity to infiltrate, harvest and re-use, evapotranspire, capture, or treat at least the design capture volume. (Also see discussion on hydrologic conditions of concern, below.)

d. Implement LID on a regional basis. For example, several developments could propose a regional system to address storm water runoff from all the participating developments. The pervious areas to which the runoff from the impervious areas are connected should have the capacity to infiltrate, harvest and re-use, evapotranspire, capture, or treat at least the design capture volume from the entire tributary area. (Also see discussion on hydrologic conditions of concern, below.)