SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD DRAFT MS4 PERMIT: A CASE STUDY

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On March 27, 2013, the San Diego Regional Water Quality Control Board (Region 9) ("RWQCB") released its Revised Tentative Order No. R9-2013-0001 (National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds within the San Diego Region) (hereafter, "Revised Draft Permit"). This article analyzes four components of the Revised Draft Permit, and identifies concerns with the Revised Draft Permit's treatment of those components based on the evidence that was before the RWQCB during its crafting of the Revised Draft Permit. The four components of the Revised Draft Permit are: hydromodification BMP requirements, the identification of a "pre-development" condition, Low Impact Development and the removal of pollutants in lieu of retaining stormwater onsite, and sediment transport requirements.

I. Hydromodification BMP Requirements

The Revised Draft Permit's Requirements

The Revised Draft Permit mandates that Copermittees require Priority Development Projects[1] to implement onsite Best Management Practices[2] ("BMPs") to manage hydromodification that may be caused by storm water runoff discharged from a project such that post-project runoff conditions must not exceed pre-development runoff conditions by more than 10 percent (for the range of flows that result in increased potential for erosion, or degraded instream habitat downstream of Priority Development Projects). (Revised Draft Permit, Provision E.3.c.(2)(a).)

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[1] Priority Development Projects include: new development projects that create 10,000 square feet or more of impervious surfaces (collectively over the entire project site), or redevelopment projects that create or replace 5,000 square feet or more of impervious surface (collectively over the entire project site); new projects that create 5,000 square feet or more of impervious surface (collectively over the entire project site), and support restaurant, hillside development project, parking lot, or street, road, highway, freeway and driveway uses; new or redevelopment projects that create or replace 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharge directly to an Environmentally Sensitive Area; new development projects that support use of an automotive repair shop or retail gasoline outlet, and new or redevelopment projects that result in the disturbance of one or more acre of land and are expected to generate pollutants post construction. (Revised Draft Permit, Provision E.3.b.(1))

[2] The Revised Draft Permit defines Best Management Practices as "Defined in 40 CFR 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage." (Revised Draft Permit, Attachment C, p. C-2.)

Copermittees have the discretion to exempt a Priority Development Project from Provision E.3.c.(2)(a)'s hydromodification management BMP performance requirements in three limited circumstances: where the project discharges storm water runoff to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean; where the project discharges stormwater runoff to conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific ocean; where the project discharges storm water runoff to an area identified by the Copermitee as appropriate for an exemption by the Watershed Management Area Analysis incorporated into the Water Quality Improvement Plan pursuant to Provision B.3.b.(4). (Revised Draft Permit, Provision E.3.c.(2)(d).) The Fact Sheet in support of the Revised Draft Permit ("Fact Sheet') states that, other than the projects exempted through the Watershed Management Area Analysis, the exemptions are considered appropriative because there is no threat of erosion to downstream receiving waters. (Fact Sheet, page F-102.)

The RWQCB describes its position regarding its ability to include the hydromodification management requirements in the Revised Draft Permit in its Response to Comments on Tentative Order No. R9-2013-0001 ("Response to Comments"). Specifically, the Board states that federal law mandates that MS4 permits require management practices that will result in reducing pollutants to the maximum extent possible. The RWQCB states that the Revised Draft Permit's requirement that Copermittees require Priority Development Projects to control post-project runoff flow rates and durations so that they do not exceed pre-development runoff flow rates and durations by more than ten percent is appropriate and necessary to reduce erosion and the discharge of pollutants into receiving waters. (Response to Comments, pages 43-45.) In response to concerns regarding the potential requirement of hydromodification management BMPs in instances where hydromodification would not take place, the RWQCB included in the Revised Draft Permit the exemption described above for projects that discharge to conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to the receiving waters. (*Id*.) The RWQCB, however, did not identify the extent to which such channels exist and would be a practical response to the challenge presented by complying with the hydromodification requirements in various venues.

In response to comments regarding the RWQCB's ability to regulate storm flow through hydromodification management requirements, the RWQCB states that the hydromodification management BMP requirements are for the control of pollutants in storm water discharges from the MS4. (Response to Comments, pages. 58-60.) While storm flow itself may be regulated as a result of the regulation of the pollutants within those flows, the RWQCB states that the hydromodification management BMP requirements are necessary to control the discharge of pollutants generated by new development and significant redevelopment projects in storm water discharges from the MS4 to the MEP. (*Id*.)

The Revised Draft Permit's Requirements are Unsupported

Both the Fact Sheet in support of the Revised Draft Permit and the RWQCB's Response to Comments cite to certain evidence that the RWQCB claims supports the hydromodification BMP requirements included in the Revised Draft Permit. However, as described below, this evidence does not support the manner in which the RWQCB has incorporated hydromodification BMP requirements, particularly in regard to the Revised Draft Permit's failure to categorically exempt from compliance with the Hydromodification BMP requirements those projects that will discharge to a hardened channel that is not lined with concrete.

The Fact Sheet cites Assessing the Health of Southern California Streams, Stormwater Monitoring Coalition, Fact Sheet (Fact Sheet page F-89, Footnote 29[3]) ("SWMC Fact Sheet") in support of its claim that hydromodification is largely responsible for stream system degradation in San Diego County and that steam stressors including percent sands and fines present, channel alteration, and riparian disturbance are related to physical habitat changes caused by hydromodification. In the preparation of the SWMC Fact Sheet, more than 120 sites were sampled to provide data to make this determination, and the Southern California index of biotic integrity used to differentiate stream biological condition. The determination of relative degradation of stream (as compared to minimally disturbed reference sites) was made using a statistical method known as relative risk analysis. However, the SWMC Fact Sheet contains no discussion or presentation of the stream channel conditions found at the more than 120 sites used for the risk analysis.

Further, the SWMC Fact Sheet does not provide any data or support for modifying the existing hydromodification control requirements for significantly hardened channels defined in the 2007 version of the San Diego County MS4 Permit, or the process for obtaining a waiver from onsite compliance per the 2009 approved San Diego Hydromodification Management Program. The SWMC Fact Sheet describes an on-going study of Southern California streams and their biological characteristics relative to changes potentially caused by hydromodification. However, the SWMC Fact Sheet makes no distinction in stream susceptibility to hydromodification for those systems that are already significantly hardened. Accordingly, the SWMC Fact Sheet does not support any conclusions regarding the specific effects of or susceptibility to hydromodification on creeks, streams and associated habitats in San Diego County, or limiting the Draft Revised Permit's hydromodification exemption to only concrete lined channels.

The Fact Sheet cites Schueler and Holland, 2000, Storm Water Strategies for Arid and Semi-Arid Watersheds (article 66) The Practice of Watershed Protection (Fact Sheet page F-90, Footnote 30) to support its finding that increases in watershed imperviousness of 9-22% can result in increased peak flow rates and that these increased flow rates have an effect on channel morphology. This article describes climatalogical and hydrological variables that influence stormwater runoff generation in the arid west, in general, and provides recommendations for managing stormwater runoff using best practices to control pollutants in runoff and protect receiving waters from geomorphological changes. It does not include or address any issue related to already hardened channels systems or their susceptibility to the effects of hydromodification as a result of urban development.

[3] All references to footnotes within the Fact Sheet are in reference to the footnotes as they appear in the March 27, 2013 strikeout version of the Fact Sheet, recognizing that footnote references may change in the final version of the Fact Sheet.

The Fact Sheet cites Stein, E. and Zaleski S., 2005. Technical Report 475. Managing Runoff to Protect Natural Streams: The Latest Developments on Investigation and Management of Hydromodification in California. December 30, 2005. (Fact Sheet page F-90, Footnote 31) for the proposition that increases in uncontrolled imperviousness of as little as 3-10% can result in physical degradation of intermittent and ephemeral streams, and that stream systems in California are more susceptible to morphological changes than other areas in the US. However, the technical paper itself contains qualifying findings, not addressed by RWQCB in the Fact Sheet, concerning management of hydromodification effects. Specifically, Stein and Zaleski conclude that "not all streams will respond in the same manner [to the effects of hydromodification]" and that "Certain management strategies need to account for differences in stream type, stage of channel adjustment, current and expected amount of basin impervious cover, and existing or planned BMPs." (*Stein & Zaleski,* at page 15.)

Further, from a planning perspective, the authors of the technical report recommend that hydromodification should be addressed in both General and Specific Plans in terms of the location and design of new development, as site-by-site or project-specific approaches tend to be less effective and more costly to implement. (*Id.,* pages 11-12.) The authors go on to recommend that streams be surveyed and classified in order to identify areas with the greatest risk of impact from hydromodification. (*Id.,* page 15.) Taken collectively, these statements support recognition of the nature of channel condition in establishing the need for protection from hydromodification effects, which the Draft Revised Permit does not do. To rely on this article for support, the RWQCB would need to defer the proposed hydromodification provision to watershed specific implementation under each WQIP rather than the broad implementation proposed in the Draft Revised Permit.

The Fact Sheet further cites the USEPA, Reducing Stormwater Costs through Low Impact Development Strategies and Practices, December 2007 (Fact Sheet, page F-90 Footnote 32) to support the use of water quality and hydromodification control approaches using Low Impact Development ("LID") type controls, applied at a site scale regardless of receiving water or watershed condition. This USEPA study includes conclusions drawn from case studies done throughout the United States. The Fact Sheet cites the study to support and justify the development of hydromodification control requirements for all projects in San Diego County, yet the document does not include citation to specific evidence as to the need for or effectiveness of controls or whether they would be effective in the San Diego region as opposed to the specific case studies. The study highlights seventeen case studies of the implementation of LID principles into urban stormwater runoff management, with an emphasis on comparing the cost of installing LID BMPs to traditional or conventional stormwater management controls. However, there is no data or analysis presented concerning hydromodification; rather, LID principles are emphasized generally.

The Fact Sheet cites the website www.lowimpactdevelopment.org (Fact Sheet, page F-92 Footnote 34) in support of the Revised Draft Permit's use of the definition of Low Impact Development as crafted by the Low Impact Development Center, located in Maryland. However, this general citation offers no specific evidence or support other than to bolster the RWQCB's emphasis on LID BMPs applied at the site scale as a minimum compliance measure with MS4 permit conditions.

The Fact Sheet cites Managing Wet Weather with Green Infrastructure – Municipal Handbook: Green Streets (USEPA 2008) (Fact Sheet, page F-95 Footnote 38) to support the use of USEPA Green Streets Guidance to design and construct new roadways or significant roadway re-construction, which, if followed, allows project proponents to be exempted from Priority Development Project status. (Fact Sheet, pages F-94-F-95.) It is also cited in support of granting exemptions for construction of new or retrofit paved sidewalks, bicycle lanes, or trails that are designed to direct runoff to vegetated pervious areas (biofiltration systems, for example). According to the Fact Sheet, the exemptions are provided to "encourage these types of projects because they provide multiple environmental benefits such as promoting walking rather than driving, which will in turn improve air quality." (Fact Sheet, page F-94.)

However, the data in the publication do not address any specific requirement related to hydromodification control, but highlight the necessary consideration of the nature of the existing built environment encountered when building in urban areas. The publication's intent is clearly stated in its introduction: "This paper will evaluate programs and policies that have been used to successfully integrate green infrastructure into roads and right-of-ways." Integration of runoff controls into the context of the existing built environment is an essential consideration.

In fact, the logic cited by the RWQCB in the Fact Sheet in allowing exemptions for projects in dense urban areas that use green infrastructure techniques to the maximum extent practicable must be considered and extended to exemptions for hydromodification control when the ultimate receiving waters are significantly hardened using concrete or other armoring techniques. The Fact Sheet finds that by retrofitting the urban landscape with roadways using green infrastructure, it "recognizes that there are spatial constraints associated with these projects, and implementation of structural BMPs are not always feasible." (Fact Sheet, page F-95.) This recognition must be made equally with the need to consider or install hydromodification controls, especially when there is no threat to receiving water channel stability, and/or space constraints may preclude installation of large structural controls.

Housing, retail, and commercial development are now regulated to occur primarily in existing urban areas in order to concentrate population and employment in already dense or increasingly dense urban areas. *See* SANDAG 2050 Regional Transportation Plan, p.3-3 ["[The San Diego] region will meet or exceed [the SB 375] targets by, among other means, using land in ways that make developments more compact, conserving open space, and investing in a transportation network…"]; California Gov't Code § 65584.04(d)(2)(B) [California's metropolitan planning organizations are directed by SB 375 to consider the "availability of land suitable for urban development" -- including "opportunities for infill development and increased residential densities."]; California: A Primer on AB 32 and SB 375, Partnership for Sustainable Communities [an "[I]ncreasing the number of people living in cities and compact suburbs where transit and amenities are already in place may have a bigger impact on regional emissions, because those people will tend to walk to stores and take transit to work.".) Projects located in urban areas must comply with water quality LID treatment control requirements to the MEP, which will provide multiple environmental benefits, including improving receiving water quality for those runoff events up to the 85^{th} percentile 24-hour storm. As urban areas are already served by hardened storm drain systems and flood control channels, there will be no effect on beneficial uses in the receiving water from runoff greater than the water quality design capture volume. In fact, water quality would be expected to improve through the implementation of LID BMPs, and other benefits will be realized including decreases in traffic and associated pollutant load production, improved air quality through a reduction in vehicle traffic, and an overall increase in urban vegetation through the introduction of vegetated bioretention devices and urban street vegetation plantings as recommended in the Green Streets Guidance document.

Both the Fact Sheet and the Response to Comments cite E.D. Stein, F. Federico, D.B. Booth, B.P. Bledsoe, C. Bowles, Z. Rubin, G.M. Kondolf, A. Sengupta. Technical Report 667. Southern California Coastal Water Research Project. Costa Mesa, CA (2012) (Fact Sheet page F-101 Footnote 41; Response to Comments, pages 171, 183-184). The Fact Sheet cites Technical Report 667 in support of the development and use of an Alternative Compliance Program for those Priority Development Projects that cannot manage the applicable hydromodification control volume onsite, and instead require an off-site location in order to provide equivalent control or in-lieu payments to a fund providing resources to upstream or across watershed boundary projects. (Fact Sheet, page 101.) In addition, the RWQCB's Response to Comments cites the Technical Report in response to stakeholder comments in support of the very limited granting of exemptions to Priority Development Projects for installing onsite hydromodification control.

An Alternative Compliance Program is an established element of fourth term Phase I MS4 permits in California. However, with respect to considering and granting limited hydromodification control exemptions as described in the Response to Comments, at pages 171, 183-184, and 190, the RWQCB misinterprets the Technical Report's findings and the findings of an underlying scientific study cited in the report, and it does not consider other important findings and statements made in the report to support consideration of such exemptions.

In responding to comments regarding Hydromodification BMP requirements, the RWQCB cites two of the Technical Report's findings to support the statement that it "disagrees conceptually that blanket exemptions should be granted to all redevelopment projects that discharge to hardened channels." (Response to Comments, pages 183-184). First, the Regional Board incorrectly cites the Technical Report's finding that "the exemption of many small projects from hydromodification controls can result in cumulative impacts to downstream waterbodies...." (Technical Report 667, page 26; see Response to Comments, pages 183 and 190) This finding was made relative to receiving waters that are known to be susceptible to the additive effects of hydromodification, not with specific respect to receiving waters that are already concrete lined or otherwise significantly hardened. Moreover, the quotation's placement in the report is (i) found within a discussion of watershed scale hydromodification management concepts (especially as it applies to known or potentially susceptible receiving waters), not with specific respect to receiving waters that are already significantly hardened, and (ii) within a specific discussion of how current management strategies in municipal stormwater permits apply hydromodification standards; the author's note that requiring LID at all projects is positive measure for hydromodification, but the RWQCB's citation to Technical Report 667 does not appear to acknowledge this point.

The RWQCB cites the Technical Report work done by Booth and Jackson (1997) in King County, Washington to support its position that blanket exemptions not be granted to Priority Development Projects. This peer reviewed article described work done in an area undergoing rapid urbanization in east King County, Washington, where stream hydromodification sensitivity to land development was being recognized and measured. The empirical underpinning of the article was the changes noted in watershed imperviousness as a result of land development and corresponding changes in receiving water geomorphology as a result of development induced hydromodification. The watersheds and streams draining those watersheds were predominately under forest cover (see Booth and Jackson (1997) Table 1), which is unlike any receiving water system in San Diego County, and the specific stream systems were "natural" in channel condition. The article did not mention or address watersheds containing hardened receiving water channels. The conditions described by Booth and Jackson (1997) are much different and not representative of the conditions experienced by projects being developed within urban areas served by already hardened channel systems, and therefore do not support the RWQCB's position.

Technical Report 667 addresses the fact that stormwater permits may offer exemptions "for projects discharging to hardened channels or waterbodies," and cautions that "these exemptions may not be supportive of future stream restoration possibilities." Yet, its authors hedge such statements by stating that "a further limitation of the current permit structure is that there is no consideration of project characteristics such as position within the watershed and sensitivity of the receiving water reach......" (Technical Report 667, page 26.)

Second, the RWQCB repeatedly quotes Technical Report 667's finding that "an effective management program will likely include combinations of onsite measures (e.g., low-impact development techniques), in-stream measures (e.g., stream habitat restoration), and off-site measures. Off-site measures may include compensatory mitigation measures at upstream locations that are designed to help restore and manage flow and sediment yield in the watershed." (Technical Report 667, Page 26; see Response to Comments, pages 171, 184, 190; Fact Sheet, Page F-101).

The RWQCB cites to this quote to (i) support inclusion of the Alternative Compliance Program (Response to Comments, page 171), and (ii) support granting limited exemptions to Priority Development Projects for hydromodification control (Response to Comments, pages 184 and 190). While it is true that alternative compliance options should exist for those projects that drain to receiving waters known or believed to be susceptible to hydromodification effects, it is inappropriate to consider such options for projects that drain to already hardened channel systems because there is no threat, now or in the future, to downstream beneficial uses as a result of redevelopment. There is no scientific or technical nexus between the impact on the receiving water and the need for control. At worst case, any redevelopment project qualifying as a Priority Development Projects will contribute at least the same amount of runoff to the receiving water and likely much less if LID BMPs are feasible for implementation.

In the same section of comprehensive approaches to hydromodification management described in Technical Report 667 from where the quotation is derived, Technical Report 667's authors state that "the variety of types and conditions of receiving waters should result in a range of requirements. This also means that objectives, and the management strategies employed to reach them, will need to acknowledge pre-existing impacts associated with historical land uses." The RWQCB must also consider this type of information in establishing appropriate exemptions for already hardened channel systems in urban areas within its jurisdiction.

The Revised Draft Permit's treatment of hydromodification management BMPs represents a significant change from the Final Hydromodification Plan for San Diego County, dated March 2011 ("San Diego HMP"). For redevelopment projects, these performance requirements are more stringent than the performance requirements of the San Diego HMP because they require evaluation of pre-development runoff conditions rather than pre-project runoff conditions.[4] Pre-development runoff conditions are defined as approximate flow rates and durations that exist or existed onsite before land development occurs. (Revised Draft Permit, Attachment C, page C-9.) For redevelopment projects, this equates to runoff conditions from the project footprint assuming infiltration characteristics of the underlying soil, and existing grade (i.e., using the parameters of a pervious area rather than an impervious area).

For many redevelopment projects, the difference between pre-development conditions and pre-project conditions is significant. This would require redevelopment projects on sites that are fully built to size hydromodification management BMPs as large as they would have been sized for a new development based on an estimate of the pre-project condition, yet they must be fit within the constraints of an already developed site. Furthermore, the change from a pre-project condition to pre-development condition requirement effectively invalidates some of the potential exemptions that certain redevelopment projects could have applied for under the approved San Diego HMP. Those approved exemptions could have facilitated the redevelopment process, encouraging redevelopment over new development. The exemptions are reasonable and are supported by extensive science and evidence. For example, under the San Diego HMP, projects that reduce impervious areas and reduce 2-year and 10-year peak flows to all outlets would be exempt. This exemption was a simple way to encourage redevelopment by removing the significant burden of hydromodification management BMPs, while achieving a net improvement to the watershed. Under the Revised Draft Permit, if adopted, this exemption would be effectively invalidated by the requirement to consider pre-development condition instead of pre-project condition because no project can reduce imperviousness below a pre-development condition. (Brown and Caldwell, Final Hydromodification Management Plan, prepared for County of San Diego, California, January 13, 2011.)

The other San Diego HMP exemption that may be invalidated or made more difficult to achieve by the Revised Draft Permit requirement to consider pre-development condition is its urban infill exemption. In the case of the urban infill exemption, a considerable effort was expended by the Copermittees, the San Diego HMP consultant, and the Technical Advisory Committee to prepare a cumulative impacts analysis to determine the thresholds and criteria for this exemption, and it was approved by the RWQCB as part of the San Diego HMP.

[4] The State Water Resources Control Board recently concluded that determining pre-development conditions and using them as the baseline was not feasible at this time. (See e.g. SWRCB California Department of Transportation Municipal Separate Storm Sewer System (MS4) Permit Comment Response Report (April 27, 2012), at page 4.).

The Revised Draft Permit also presents a list of criteria for exemptions from hydromodification management BMP performance requirements. (Provision E.3.c.(2)(d)) This list of criteria omits certain exemptions that were included in the RWQCB's 2007 MS4 permit, pursuant to Order No. R9-2007-0001. Exemptions available under R9-2007-0001 that are not included in the Revised Draft Permit are: channels that are "significantly hardened (e.g., with rip-rap, sackcrete, etc.)" (note this means channels hardened with materials other than concrete – channels that are concrete lined to the Ocean will still be exempt), and projects where "the sub-watersheds below the projects' discharge points are highly impervious (e.g., >70%) and the potential for single-project and/or cumulative impacts is minimal." The list also does not include exempt river reaches that were approved as part of the Final HMP dated March 2011 (portions of Otay River, San Diego River, San Dieguito River, San Luis Rey River, and Sweetwater River). These exemptions were based on extensive studies. (*See* Brown and Caldwell, Final Hydromodification Management Plan, prepared for County of San Diego, California, January 13, 2011.) While the Revised Draft Permit does not preclude these previously exempt channels, rivers, or highly impervious watershed areas from being exempt under a Water Quality Improvement Plan (WQIP), it requires a complete new analysis ("Watershed Management Area Analysis" defined in Provision B.3.b.(4)(a)), and vetting through the public review and approval process of the WQIP in order to re-establish the exemptions through the WQIP. Copermittees, the San Diego HMP consultant, and the Technical Advisory Committee have already expended considerable efforts to identify criteria for exempt river reaches. The Revised Draft Permit does not identify any evidence that supports this change. Copermittees should not have to prepare a new study to maintain these exemptions, as they have already been reviewed and approved during the development of the San Diego HMP.

Finally, pursuant to Provision E.3.(d) of the Revised Draft Permit, the updated performance requirements for hydromodification management BMPs must be incorporated into the BMP Design Manual (formerly Standard Urban Stormwater Mitigation Plan). Based on Provision F.2.b, this will be due three months following approval of the WQIPs. Pursuant to Provision E.3.d, until a Copermittee has updated its BMP Design Manual, the Copermittee must continue implementing its current BMP Design Manual. On this basis, until the BMP Design Manual is updated and implemented, a pre-project condition rather than pre-development condition will be the standard for curve-matching to meet the San Diego HMP criteria, and all exemptions currently available in the approved San Diego HMP will remain available. New HMP exemptions may be created where appropriate through the WQIP process.

II. **Hydromodification Baseline: Pre-Development Runoff Conditions**

The Revised Draft Permit's Requirements

The Revised Draft Order requires that post-project runoff conditions mimic "pre-*development* runoff conditions", as opposed to pre-*project* runoff conditions. (Revised Draft Order, Provision E.3.c.(2)(a); Fact Sheet, p. F-99.) The Revised Draft Order defines Pre-Development Runoff Conditions as "Approximate flow rates and durations that exist or existed onsite before land development occurs. For new development projects, this equates to runoff conditions immediately before project construction. For redevelopment projects, this equates to runoff conditions from the project footprint assuming infiltration characteristics of the underlying soil, and existing grade. Runoff coefficients of concrete or asphalt must not be used. A redevelopment Priority Development Project must use available information pertaining to existing underlying soil type and onsite existing grade to estimate pre-development runoff conditions." (Revised Draft Permit, p. C-8.)

The RWQCB stated, without evidence, that using a hydrology baseline that approximates that of an undeveloped, natural watershed is the only way to facilitate the return of more natural hydrological conditions to already built-out watersheds, and ultimately improved stream health, and that using pre-*project* hydrology as a baseline for redevelopment projects would result in propagating the unnatural hydrology of urbanized areas, which would not support conditions for restoring degraded or channelized stream segments. Furthermore, reducing the volume of storm water runoff associated with the urbanized flow regime will also result in reducing the discharge of pollutants into receiving waters, since storm water runoff from impervious surfaces contains untreated pollutants. (Fact Sheet, page F-99.)

The Revised Draft Permit indicates that the RWQCB understands that approximating the pre-development runoff condition associated with a redevelopment site is not straightforward because factors such as natural grade and native vegetation for the site cannot be precisely known. (Fact Sheet, page F-99) For this reason, the RWQCB expects project designers and the Copermittees to approximate pre-development runoff conditions using existing onsite grade and assuming the infiltration characteristics of the underlying soil. (Fact Sheet, pages F-99 – F-100). Redevelopment projects are to use available information pertaining to existing underlying soil types (such as soil maps published by the National Resource Conservation Service), onsite existing grade, and any other readily available pertinent information to estimate pre-development runoff conditions. (*Id*.) The RWQCB asserts that an area's pre-development hydrology can only be roughly estimated and cannot be precisely known, but that using the hydrology of a natural condition, even if not precisely known, will provide significant benefit to receiving waters over using the hydrology associated with developed surfaces. The RWQCB finds that in order to achieve the goals of the Clean Water Act to "restore and maintain the chemical, physical, and biological integrity of the nation's waters [emphasis added]," the most appropriate standard to use for hydromodification management is the standard associated with the pre-development condition. (Fact Sheet, pages F-99-F-100.)

The Revised Draft Permit's Requirements are Unsupported

The RWQCB's findings in support of these hydromodification requirements are contradicted, however, by the California State Water Resources Control Board's ("SWRCB") statements as part of the 2012 renewal of the California Department of Transportation's multiple separate storm sewer system permit. In its April 27, 2012 response to comments regarding hydromodification, the SWRCB stated that the use of a "pre-development" standard for hydromodification is not feasible at this time. (See SWRCB California Department of Transportation Municipal Separate Storm Sewer System (MS4) Permit Comment Response Report (April 27, 2012), at page 4.) Specifically, the Board stated:

> It is not possible to develop a mutually agreed-upon standard for pre-development hydrology without a lengthy stakeholder process.

> One of the biggest complicating factors is that our hydrology has been significantly altered by the addition of dry weather flows, sometimes in volumes that are 3-5 times the volume of stormwater flows. Biocriteria need to be developed for the state and the ecological limits of flow alteration that can be tolerated and still have some favorable biological outcome need to be determined. This is still 5-10 years away. The pre-project standard is appropriate at this time.

The RWQCB should not take action to implement an approach that the SWRCB has determined to be infeasible. (See United States v. California (SWRCB) (1986) 182 Cal.App.3d 82, 109.)

III. **LID and Onsite Retention of Stormwater**

The Revised Draft Permit's Requirements

The Revised Draft Permit modifies its prior provisions relating to structural BMP performance requirements for Priority Development Projects, requiring that those projects implement onsite structural BMPs to control pollutants in storm water that may be discharged from a project. Specifically, under Provision E.3.c.(1)(a) of the Revised Draft Permit, Priority Development Projects are required to implement Low Impact Development (LID) BMPs that are designed to retain onsite 100 percent of the pollutants contained in the volume of storm water runoff produced from a 24-hour 85th percentile storm event.[5] (Revised Draft Permit, p. 93.)

The Fact Sheet for the Revised Draft Permit indicates that the 85th percentile storm event is the design capture volume that has been used for treatment control BMPs previously, and that it is the MEP standard recognized by the RWQCB and is consistent with the Fourth Term MS4 permits for Los Angeles, Orange, Riverside and Ventura Counties. (Fact Sheet, page F-96.)

Under Provision E.3.c.(1)(a)'s onsite retention requirements, the designer of a Priority Development Project would select a system of BMPs that would retain onsite – through interception, storage, infiltration or evaporation – 100 percent of the pollutants in the 85th percentile storm event design capture volume. (See Fact Sheet, page F-97.) The Fact Sheet for the Revised Draft Permit states that such retention BMPs are necessary to capture and retain the pollutants generated from a Priority Development Project. (*Id*.) Pursuant to Provision E.3.c.(1)(b), in the event a Priority Development Project determines that onsite retention is not

[5] The Revised Draft Permit describes a 24-hour 85th percentile storm event as follows: "This volume is not a single volume to be applied to all areas covered by this Order. The size of the 85th percentile storm event is different for various parts of the San Diego Region. The Copermittees are encouraged to calculate the 85th percentile storm event for each of its jurisdictions using local rain data pertinent to its particular jurisdiction. In addition, isopluvial maps may be used to extrapolate rainfall data to areas where insufficient data exists in order to determine the volume of the local 85th percentile storm event in such areas. Where the Copermittees will use isopluvial maps to determine the 85th percentile storm event in areas lacking rain data, the Copermittees must describe their method for using isopluvial maps in its BMP Design Manuals." (Revised Draft Permit, page. 93, former Footnote 27.)

feasible, it may utilize flow-through treatment control BMPs to achieve the equivalent pollutant load removal that would have been achieved if the design capture volume were fully retained onsite. However, "In any event, no matter what types of BMPs (or combination of BMPs) are chosen, 100 percent of the pollutants contained in the design capture volume must not be allowed to be discharged from the Priority Development Project." (*Id*.)

Finally, if onsite retention is found to be cost prohibitive or not to provide the water quality benefit to the watershed as would implementing BMPs elsewhere in the watershed, Provision E.3.c.(1)(c) allows for the use of a combination of onsite retention BMPs, and the implementation of an Alternative Compliance Program described in Provision E.3.c.(3).

The Revised Draft Permit's Requirements are Infeasible within the Region

As described below, the requirement is infeasible and not supported by evidence cited to in the Revised Draft Permit, the Fact Sheet that supports it, the RWQCB's Response to Comment, or elsewhere.

Infiltration is Largely Infeasible in Region 9

The soil types in Region 9, and particularly San Diego County, are likely infeasible for infiltration where stormwater could eventually reach the underground aquifer. More than 70 percent of the soil types found in San Diego County possess a Soil Hydrologic Group classification of C and D (USDA, 1973). A large majority of the land area possesses a classification of C or D (SANDAG, 2007) and soft/hard rock (CGS, 2007). Using infiltration as a preferred method of stormwater remediation county-wide, therefore, is unsupported. Clearly stated, in the appropriate soil type, infiltration is a preferred alternative. In the wrong soil type the results could be catastrophic. (See photos 1 & 2).

Photo 1 – La Jolla Landslide (Ardath Shale Formation, Claystone, Hydrologic Group D)

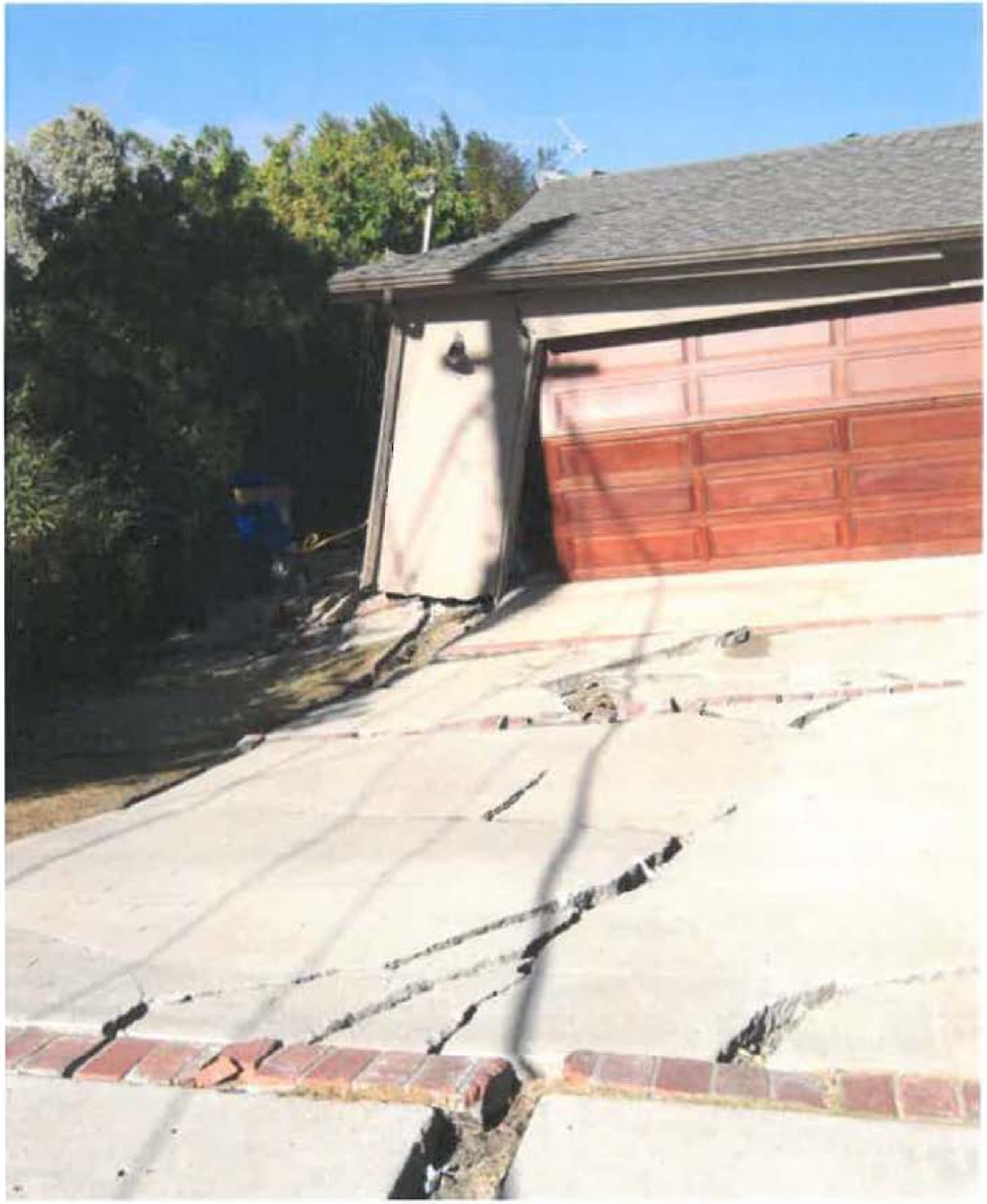


Photo 2 – La Jolla landslide (Ardath Shale Formation, Claystone, Hydrologic D)

For 70 years or more, both geotechnical engineers and civil engineers have designed projects to minimize water infiltration into the soils around and adjacent to buildings. A majority of geotechnical construction litigation is water intrusion related. (See Das, Braja M., Principles of

Geotechnical Engineering, 1994.) Water in clay based soils causes heaving, settling and failure of pavement, retaining walls and buildings. In extreme cases, these soils are prone to slippage, sinkholes or landslides. Additionally, when water enters these soil types it can travel laterally until it finds a utility trench, water or sewer line and then can undermine those systems. (Living with Expansive Soils, Marshall Addison, PhD. http://milliondollarstudent.com/ramjack/PDF/Living_with_Expansive_Soils.pdf; Low Impact Development Handbook, Stormwater Management Strategies, December 31, 2007, Page 39.) The water in these soils cannot infiltrate deep into the ground but moves as it can find voids and areas of better permeability. (Low Impact Development Handbook, Stormwater Management Strategies, December 31, 2007, Page 39.) (See photo 3, below.)

Photo 3 – Perched water visible on lower half of hillside (water migration)

Additionally, there are areas of the County where the soils are hard rock and infiltration cannot occur because water does not easily infiltrate into rock. (United States Department of Agriculture (USDA), Soil Survey, San Diego Area, California, December, 1973; SANDAG, County of San Diego Hydrology Manual Soil Hydrologic Group Map, 2007. California Geologic Survey (CGS), Preliminary Surface Geologic Materials Map, 2007.)

Since much of the construction within San Diego County is slab on grade construction, retaining water onsite through infiltration can even cause minor health and safety problems. Cured concrete is still a porous material. If water is present in the soil, the slab can wick up water into the building (photos 4, 5 & 6). As buildings are well insulated and energy efficient, this water can lead to mold growth and damage anything placed on the slab (floor coverings, cabinets, furnishings). (Uniform Building Code, Title 24[6].) Water in a warm environment, without sufficient airflow exchange (because of better insulation, windows, etc.) provides the ideal conditions that lead to mold growth. This could create a major construction defect litigation problem for a builder or developer. Again, the geotechnical engineers and civil engineers have stressed the importance of moving water away from building as efficiently and quickly as possible for just this reason. (Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary, American Concrete Institute [requires water barriers below slabs].) While ACI requires this, typically the entire footing doesn't receive a water barrier. Additionally, during construction the water barrier often may be punctured or moved and may not be as effective as called for in the ACI standard.

Photo 4- water migration through slab into cabinetry

[6] This section of the Uniform Building Code includes energy conservation measures, including requirements for better windows, improved weatherstripping, and additional insulation, which all lead to "tighter" and more energy efficient buildings. This is contrasted with older buildings, which "breathe" meaning that they have sufficient air flow to evaporate water wicking up through the slab before it becomes a problem. In newer buildings, water cannot evaporate and problem, such as mold, result.


Photo 5 – water migration through slab (mold under vinyl flooring)

Photo 6 – water migration through slab (white coating is efflorescence)

Retention and Re-use Requirements Raise Additional Concerns

Where onsite infiltration is not feasible, the next option is the capture and storage of stormwater for re-use. If a project will capture water in order to store it, a storage container must be constructed. Since an 85th percentile, 24 hour duration rain event can produce between ½" to ¾" of rainfall in a given area of San Diego (and up to 1-½" in mountainous areas, according to the 85th Percentile Precipitation Isopluvial Map of the San Diego County Hydrology Manual; see also http://www.projectcleanwater.org/html/wg_susmp.html), the amount of water to be stored could be considerable.

The Revised Draft Permit does not effectively address what happens with the retained water or how quickly it needs to be used, since the storage capacity would need to be utilized again for future rain events. Rain barrels are often mentioned as a solution, but care must be taken with regard to water breeding insects. Additionally, most commercially available rain barrels are made of plastic which degrades in the UV from sunlight. After a few years they become brittle and are prone to failure, putting water into the surrounding soils next to the building. Additionally, utilizing the optimum number of rain barrels is impractical, as it is too large to have a significant impact on water usage due to the erratic and clustered nature of the precipitation in San Diego County. According to a continuous simulation study prepared with hourly precipitation data of Lindbergh Airport in San Diego (the best precipitation data set in the County), the optimum rain barrel volume for retention purposes is about 12 – 50 gallon barrels for every 1,000 sq-ft of roof, using the theory of Diminishing Returns. (Parra, StormCon 2010.) Cisterns are another option mentioned as a potentially viable solution. Burying a tank in the ground may not be feasible for infill and redevelopment projects due to various Building Code issues.

Unintended Consequences

Both California AB 32 and SB 375 are landmark environmental laws addressing climate change and land use adaptation to reduce production of greenhouse gases. The intent of this legislation is to:

1. Use the regional transportation planning process to achieve reductions in greenhouse gas emissions consistent with AB 32's goals;
2. Offer California Environmental Quality Act incentives to encourage projects that are consistent with a regional plan that achieves greenhouse gas emission reductions; and
3. Coordinate the regional housing needs allocation process with the regional transportation process while maintaining local authority over land use decisions

The result is to encourage growth to occur inwards into the existing urban footprint. This is defined as "in-fill" development. An unintended consequence of the Revised Draft Permit is that its requirements actually make it more attractive and cost effective to build away from the existing urban footprint because of the land necessary to comply with the new requirements in the Revised Draft Permit. The 100% pollutant capture requirement and the removal of hydromodification exemptions on infill development render these projects both technically and financially infeasible. (Refer to photograph 7.)

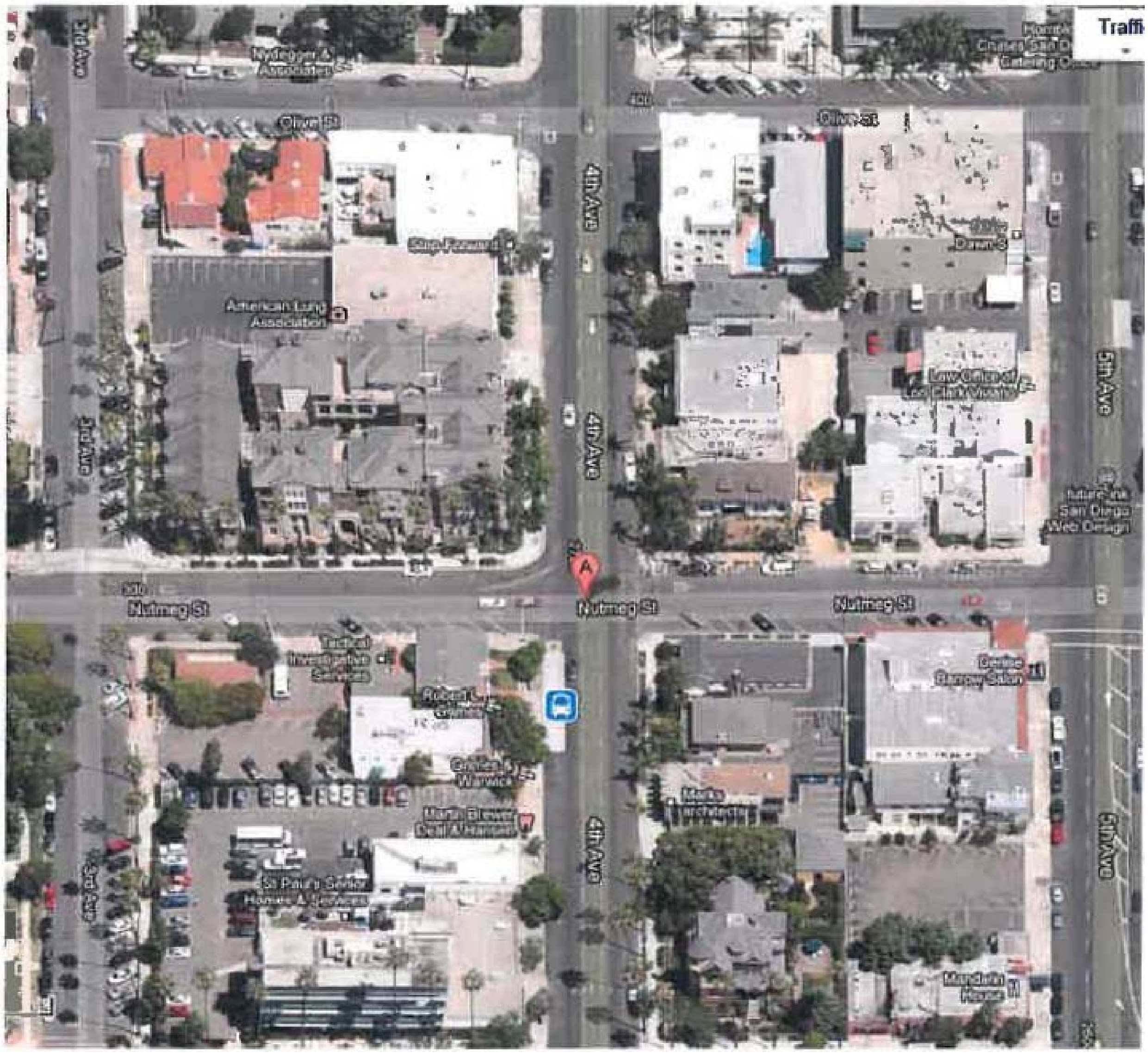


Photo 7 mid-rise condo project at the NW corner of 4th and Nutmeg, San Diego

Photo 7 shows a smart growth project on the northwest corner of 4th & Nutmeg in San Diego's highly urbanized Banker's Hill neighborhood: transit friendly (transit oriented development, TOD); walkable neighborhood; near parks, shopping and recreation (2 blocks from Balboa Park); near San Diego's airport; near Downtown/Hillcrest/Mission Valley work environments; and within the Smart Car (car 2 go) user footprint. Under the Revised Draft Permit, this project would become infeasible because of the 100% pollutant capture (infiltration/reuse) requirement and the loss of the hydromodification exemption previously included in the HMP.

The soil type at this location will not allow for infiltration. Additionally, to achieve the requisite density there is not enough land available to allow for supersizing of BMPs. There is no place to put a retention tank except under the building's parking structure. It may be infeasible to place a tank under a building for a number of reasons: the difficulty or repairing a tank located below a building; the cost to integrate the tank into the building's foundation; if the tank were to leak, the entire building is subject to settlement issues, or failure, based on the water leaking into the surrounding soils; the added cost to operate and maintain the tank in perpetuity.

Photo 8 (street level) shows the building and that parking is located underneath the building. This is "podium" type construction and next to high-rise development, the most expensive type of construction for "smart growth" infill development. Complying with the Revised Draft Permit means this type of project becomes infeasible, both technically and financially. The Revised Draft Permit is silent on this issue and has not addressed this concern. The current language, whether intended or not, seems to eliminate this type of development project which is mandated and encouraged under SB 375.

Photo 8 – Street view: 4th and Nutmeg, San Diego (notice living units at ground level)

Whether or not water is infiltrated or stored onsite for reuse, the Revised Draft Permit includes no consideration of the fate of the pollutants existent in that water. In a storage tank or cistern, like a septic tank, gravity will cause most of the pollutants to fall to the bottom of the tank where they will remain and build up. Over time, the tank would gather year's worth of pollutants. If the tank owner is drawing the water for re-use, the water typically in any tank is drawn from the bottom, so the pollutants could be redistributed onsite. This raises questions of whether compliance with the Revised Draft Permit requirements would cause a health and safety concern to the person re-using the water, how often such a tank or cistern be emptied for cleaning, whether the mass of pollutants at the bottom of the tank would be considered a regulated waste, and how and where a property owner could dispose of such a waste. An infiltration trench or basin would have the same pollutant disposal issues. The media (soil, sand gravel, etc.) in the trench or basin would need to be excavated and disposed of.

Another major concern with the new permit standard (infiltration or retention) is that it will deprive watersheds of the water that feeds riparian ecosystems. As the Revised Draft Permit offers creek and stream restoration or rehabilitation as an alternative compliance option to onsite hydromodification management, this raises the question of how can one restore those watercourses without the water that supplies them. (33 U.S.C. §1251(a) [the Clean Water Act was enacted "to restore and maintain the chemical, physical, and biological integrity of Nation's waters"].)

The Revised Draft Permit Includes no Support for the Ability to Comply with its Requirements

As described above, the phrase "retain onsite 100% of the pollutants" was recently added to the water quality management performance standard contained in the Revised Draft Permit (San Diego Regional MS4 permit Section E.3.c.(1)(a)). Unless a Priority Development Project can infiltrate the entire design capture volume, or reliably use the runoff collected in a harvest and use cistern system, retention of 100% of pollutants is impossible, and this is especially true for several pollutants of concern including bacteria or nutrients such as nitrogen or phosphorus.

The Revised Draft Permit offers no technical support for such a standard, including studies or data cited in the Fact Sheet, Response to Comments, or otherwise, that demonstrate 100% of pollutant can be prevented from being discharged from Priority Development Projects into the MS4 and into receiving waters. On the surface, such a requirement is conceptually feasible: no discharge equals no pollutants. However, the selection and application of retention type LID BMPs, principally soil infiltration systems and rainfall harvest and use systems, are subject to a myriad of technical infeasibility constraints, of which the RWQCB and others have identified (See for example, Orange County Model WQMP requirements and supporting Technical Guidance Document--TGD). In the absence of feasible application of infiltration or harvest and use, such a standard is unachievable. Rather, Regional Boards in California use water quality treatment design criteria that require project proponents to demonstrate that it cannot reliably retain 100% of the storm water quality design volume onsite before allowing the proponent to use biofiltration or biotreatment type LID BMPs. Only until the feasibility of these systems is exhausted may the proponent be allowed to use other types of management practices.

In the discussion in the Staff Report regarding justification for using the runoff created by the 24-hr 85th percentile rainfall event as the basis for a project's design capture volume, the RWQCB cites a Southern California Coastal Water Research Project ("SCCWRP") report prepared in 2007. This report includes findings that show the majority of pollutants from urban locations in the Los Angeles area of southern California arrive in receiving waters during the "early" part of storm events, and that the "highest constituent loading was observed early in the storm season, with inter-annual variability driven more by antecedent dry period that amount of rainfall."

The SCCWRP 2007 report also found that the "first flush" effect at land use sites was a function of watershed size. In other words, the smaller the watershed, the more pronounced the first flush effect. Therefore, the author's note that "capturing constituent loads should focus on more than just the initial portion of the storm at moderate to large catchments". This statement, therefore, supports using the entire suite of LID type BMPs to manage urban runoff, including biofiltration systems, and supports using a secondary metric of sizing LID BMPs for retaining and treating 80% of the annual runoff volume in addition to capturing and treating individual rainfall events. In no case or instance cited in the SCCWRP 2007 report is there a recommendation or finding that supports a retention standard that achieves 100% pollutant containment. The aforementioned Orange County Model WQMP and TGD describe the LID BMP selection process and sizing criteria in detail (using both the 24-hr 85th percentile design storm and 80% annual runoff volume as sizing metrics), and provide several case study examples for support.

Such a restrictive and narrow definition of allowable LID BMPs is inconsistent with U.S. EPA guidance which promotes biofiltration 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 storm water. 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 a 2009 submittal from Mr. Eric Strecker, Geosyntec Consultants for the Construction Industry Coalition on Water Quality. In Mr. Strecker's analysis, 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 storm water off site, permitting planted areas to safely allow filtration of storm water.

The State Water Resources Control Board (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 tentative order and instead moves a project into "Alternative Compliance". In addition, SWRCB characterizes mimicking pre-development hydrology as a "goal," not an enforceable standard. *Found at*: http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/.

The language in the current tentative Order, while clearly specifying a volume capture approach to sizing LID BMPs, introduces an incorrect definition of LID through restrictive application of BMPs to only those that infiltrate, harvest and use rainwater, and/or evapotranspire all of the captured water. In other words, permit language now requires that projects would be limited to zero discharge of a design storm volume with no runoff whatsoever allowed.

The US EPA defines LID as follows:

> *A comprehensive stormwater management and site-design technique. Within the LID framework, the goal of any construction project is* ***to design a hydrologically functional site that mimics predevelopment conditions.*** *This is achieved by using design techniques that infiltrate,* **filter***, evaporate, and store runoff close to its source.* (emphasis added)

http://cfpub1.epa.gov/npdes/greeninfrastructure/information.cfm#glossary .

Mandating the complete onsite retention of any sizable storm volume (i.e. runoff that never leaves as surface flows) is not a reasonable approach and the tentative Order attempts in places to redefine the allowable site design elements necessary to implement this concept. The tentative Order may implement LID in a way that is contrary to the EPA definition of LID by restricting BMPs to those that only achieve zero discharge—not allowing any BMPs that appropriately "filter" runoff, such as bioretention cells or other vegetated LID BMPs. Total, 100-percent retention remains impractical and unwise in most circumstances, and is not a goal that can be achieved for most projects within reasonable costs, despite best efforts. Moreover, such a mandate abandons the goal to mimic predevelopment conditions to the extent practicable, as EPA encourages.

The retention BMPs of infiltration, harvesting, and evapotranspiration ("ET") may be described as a first tier of LID BMPs, but they should not be universally mandated to the exclusion of all other options. As the EPA definition of LID indicates, biofiltration, bioretention, filter strips, and other BMPs based on using vegetation to promote stormwater treatment via filtration are fundamental to LID implementation. These BMPs may be specified as second tier options (although they best mimic pre-development conditions), but project proponents should have considerable discretion to use these BMPs, and should not be required to apply for a feasibility exception to do so.

The use of conventional BMPs (structural treatment installations) as the principal approach for stormwater management should be a last resort, available only when objective infeasibility criteria are satisfied, and when off-site opportunities are not readily available. When LID BMPs are infeasible, and nearby off-site options are not available, the use of conventional BMPs that have been demonstrated to be effective on the pollutants of concern should be a compliance option.

IV. **Sediment Transport Requirements**

The Revised Draft Permit's Requirements

The Revised Draft Permit requires Priority Development Projects to avoid known critical sediment yield areas or implement measures that allow coarse sediment to be discharged to receiving waters, such that the sediment supply is unaffected by the project. (Revised Draft Permit, Provision E.3.c.(2)(b).) The Revised Draft Permit does not define "coarse sediment"[7] as

[7] According to the technical literature, the beginning of sediment motion is not defined by the term "coarse sediment" but by more specific terms such as (1) Nearly Uniform Cohesionless

it is used in this section. The Fact Sheet supporting the Revised Draft Permit states that the requirement is necessary because coarse sediment supply is as much an issue for causing erosive conditions to receiving streams as are accelerated flows.[8] (Fact Sheet, page F-100.)

All development involves some loss of sediment. The Revised Draft Permit requires that "critical sediment yield areas" will be identified by studying the watersheds (through the Watershed Management Area Analyses[9]). These analyses would then be incorporated into the Water Quality Improvement Plans for each watershed. Thus, a new category of "Environmentally Sensitive Areas" will be identified and protected. This would be incompatible with development on that property. To understand why introducing a new category of sensitive area into the development planning process is such a concern requires an explanation of hydromodification basics and impacts on receiving waters.

Hydromodification Basics regarding Sediment Transport

Hydromodification is primarily understood within the context of impacts, potential or realized; that is, the effects of changes within a watershed on downstream fluvial systems (i.e., canyons, creeks, streams, rivers, lakes, lagoons, etc.). A change, or a number of changes, can cause or contribute to an imbalance within a fluvial system that has been in a state of dynamic equilibrium (relative stability within a range of erosivity/degradation and sedimentation/aggradation). Related secondary impacts (secondary as a consequence, not necessarily in importance) include habitat degradation, slope failures, infrastructure failures, and increased flooding risks, among others. (ADWR, 1996, 1998; USACOE, 1994).

The most common example of hydromodification is the covering of land with impervious surfaces, which deprives the waterways of naturally occurring sediment yield, while increasing runoff volumes, durations and peaks in those same waterways. Another example is the presence of a flood control dam upstream, which tends to trap sediment but also reduces damaging peak flows and volumes. (Aspen Environmental, 2006.) For the purposes of this paper, hydromodification will be understood as a direct consequence of urbanization, the covering over of land with impervious surfaces.

Sediment (Shields, 1936; Maidment, 1992), (2) Incipient Motion on Ripple and Dune Beds (Chabery et al, 1963; Mantz, 1977) ; Mixture of Nonuniform Cohesionless Sediment Sizes (Egiazoroff, Little and Meyer, Hayashi et al, among many others), and Cohesive Sediment (Mehta, (3 studies, 1986, 1989 and 1989)).

[8] This statement oversimplifies a complex issue, as in some watersheds, fine sands, dunes and ripples, and cohesive sediments can be an important geomorphic factor. (*See* Lane and Carson; Shen and Liu; Task Committee; previous studies).

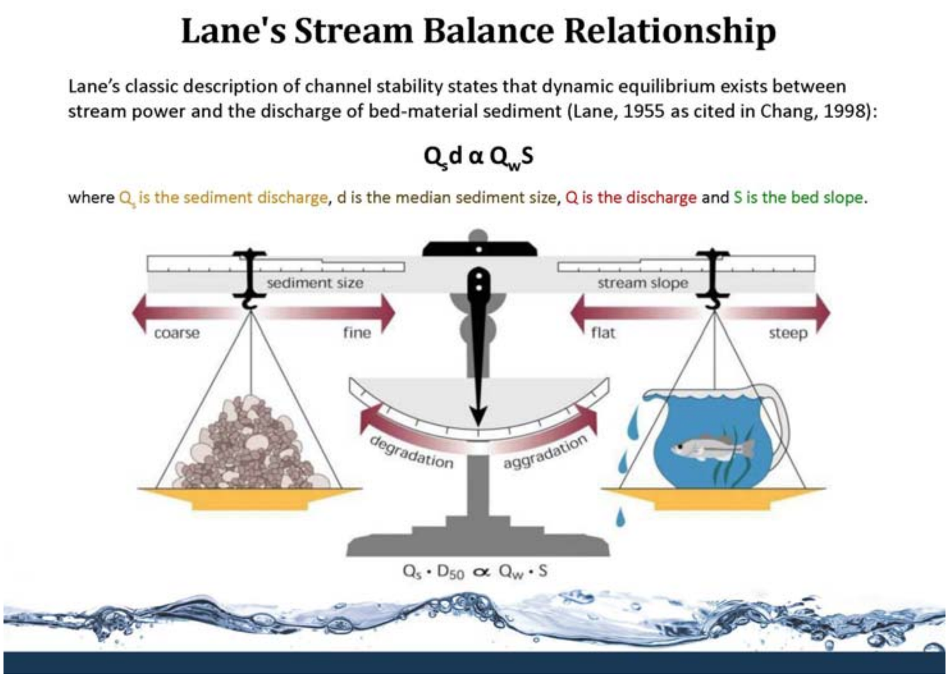
[9] The Revised Draft Permit is silent as to the method to determine such critical yield areas, which could conceivably be established based upon the USLE equation (Wischmeier et al, 1971), by sediment-delivery ratio equations (Roehl, 1962), by sediment yield empirical formulas based on real measurements (Dendy and Bolton, 1976), or by more complex mathematical formulations (Ponce, 1989).

Understanding Fluvial Processes

Lane's Stream Balance Relationship states that dynamic equilibrium exists between stream power and the discharge of bed material sediment. (Lane, 1947.) It is usually stated as:

$$Q_s * D_{50} \alpha Q_w * S$$

Where Q_s is the sediment discharge, D_{50} is the sediment size, Q_w is the (water) discharge, and S is the bed slope. This proportional relationship is often graphically illustrated with a balance, as shown below, and it is not intended to be used as an equation. Some attempts to convert this relationship into an equation have been carried out. (Ponce, 1999.) The Lane relationship shows that where adjustments or modifications occur in the watershed or in the channel (in terms of Q_w, for example), another adjustment will begin to occur to preserve the equilibrium (in terms of S or Qs, for example).



Three Local Examples

Hydromodification impacts vary, sometimes by orders of magnitude. (Hastings, 2005; Hecht, 2000.) The following three examples of fluvial systems within our region illustrate this well. Each is different, and each only represents one reach of the creek. As one travels upstream or downstream each of these creeks, impacts will vary widely.

<u>Oso Creek</u>

The photo below shows a portion of Oso Creek, approximately 1 kilometer (0.7 miles) downstream of a hardened channel. The severe degradation evident in this photo has occurred within the past 20 years, due to development of a master planned community upstream. The composition of the bed and banks is primarily loose alluvium, so erosion has not been halted. The sediment from this reach is deposited in downstream reaches and has resulted in slope failures, biological degradation and flooding impacts downstream.

Oso Creek, approximately 1 kilometer (0.7 miles) downstream of a hardened channel

Escondido Creek

By contrast, the photo below indicates a creek in dynamic equilibrium 0.7 kilometers downstream of a hardened channel. The City of Escondido, incorporated in 1888, has certainly experienced its share of development, with most of the city draining to this natural channel for more than 100 years. This photo is typical of Escondido Creek for the remaining 23 kilometers (14 miles) to the ocean. That is not to say this creek is not subject to any degradation, only that over the decades the creek has mostly adjusted to a new state of dynamic equilibrium.

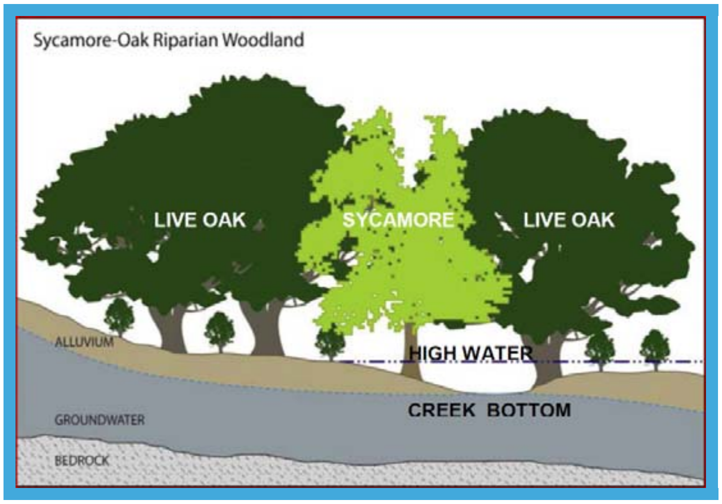

Escondido Creek in dynamic equilibrium 0.7 kilometers downstream of a hardened channel

Agua Hedionda Creek

The Agua Hedionda Creek watershed is in portions of several north San Diego jurisdictions. A 2008 Watershed Management Plan (TetraTech, 2008) identified a reach of the creek as a high priority project; Tory R. Walker Engineering, Inc. assembled a multi-disciplined team, which prepared a Preliminary Design Report for the rehabilitation of that reach. (Tory R. Walker Engineering, 2010.) The photo below illustrates the typical impacts of hydromodification within the reach, where an established Oak woodland is threatened.

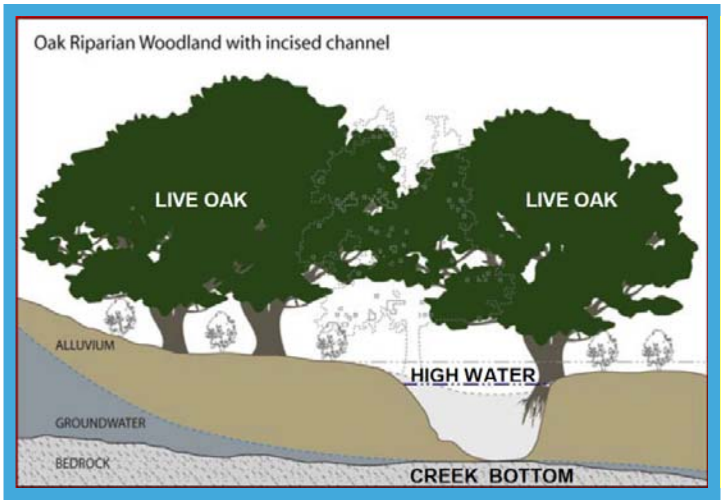
Agua Hedionda Creek in Buena Vista Park near Melrose Avenue

The figures below illustrate the effects of hydromodification over time on hypothetical stream systems. (TRWE, 2010.)



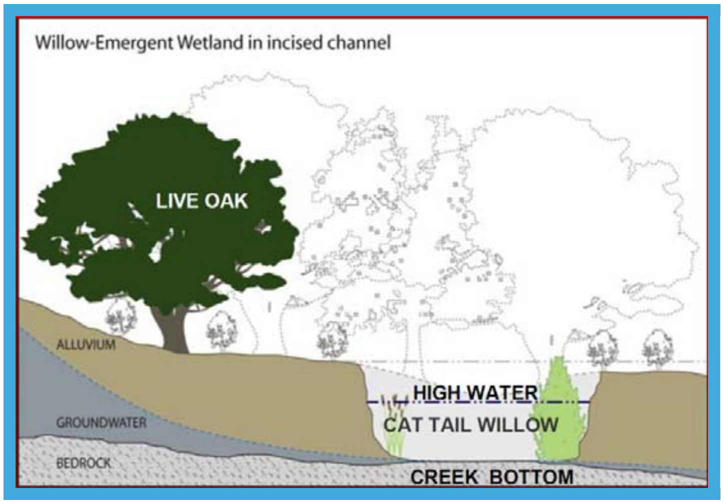
Stable System (circa 1900)

- High Groundwater Recharge
- Equilibrium Sediment Transport
- High Floodplain Function
- Low Discharge Velocities
- Dynamic and Broad Riparian Zone
- Diverse Riparian Habitat
- Sustainable Vegetation Mosaic
- Cool Seasonal Aquatic System



Early Incised System (Present)

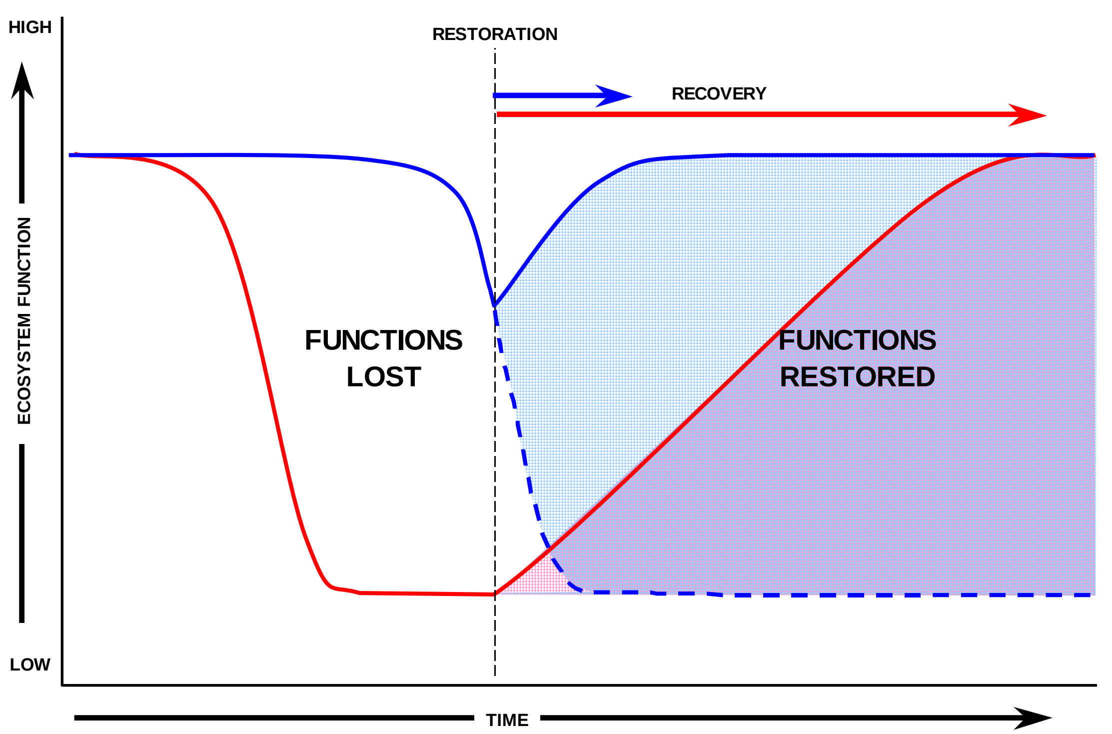
- Depressed Groundwater Table
- High Groundwater Export
- Low Groundwater Recharge
- High Channel Bank Erosion
- Confined Low Floodplain Function
- High Discharge Velocities
- Diminishing Riparian Zone Width
- Low Diversity Riparian Habitat
- Poor Riparian Plant Recruitment
- Cool Seasonal/Perennial Aquatic System



Mature Incised System (circa 2040)

- Groundwater Conditions Same as Now
- High Channel Bank Erosion
- Confined Low Floodplain Function
- High Discharge Velocities
- Diminishing Riparian Zone Width
- Low Diversity, Narrow Riparian Habitat
- High Scour Plant Loss
- Opportunistic Exotic Plant Recruitment
- Warm Seasonal/Perennial Aquatic System

Restoration of ecosystem functions that have been lost due to hydromodification may be accomplished through different mechanisms. The figure below illustrates two paths to the restoration of ecosystem functions over time – with and without human intervention to restore the lost functions. The shorter length of the "blue path" demonstrates the value of restoration/rehabilitation in a creek, whereas the length of the "red path" shows how a much longer period of time is needed for recovery of ecosystem functions when no human restorative action is taken. In the case of Agua Hedionda Creek, those ecosystem functions would be different.



Effects of Ecosystem Trajectory on Restoration Values (TRWE, 2010.)

Stabilization

Stabilization of fluvial systems has generally been considered the typical "fix" to hydromodification. (USACOE, 1994.) Stabilization can be understood very broadly to include everything from concrete lining and piping underground to streambed or bank stabilization utilizing bioengineering techniques exclusively. Between these two "ends of the spectrum" are quite a number of techniques and types of materials, used in combination or separately, to "stabilize" these dynamic systems. Common techniques include grading of new "stable" channels, creating "benches" beside channels (thus increasing flood capacity and stability), constructing drop structures to flatten the longitudinal slopes, or meandering the stream channel to lengthen it. In addition to concrete lining, materials have typically included rock riprap, natural stone, concrete block systems, turf reinforcement mats, vegetation, imported sediment and/or cobbles of a certain gradation, gabion baskets, logs, and root wads. (NRCS, 2002; WSAHGP, 2003.)

Restoration and Rehabilitation

"Restoration" usually refers to attempts to restore a system back to a previous condition, while "rehabilitation" usually refers to attempts to improve a system while accounting for mostly irreversible changes (like a hydromodified watershed). This should not be understood as "giving up" on all efforts to lessen impacts within a watershed; rather, it should be understood within the context of the graph above. Time marches on, as the saying goes, so intervention requires an understanding of where a fluvial system is currently, along with an understanding of the current and future conditions of the watershed. For this reason, most work within fluvial systems is no longer described as "restoration," but rather "rehabilitation."

Onsite Approach Presented in Draft Permit

Attempts to address sediment balance through a directive within a permit will almost always fail; the complexity of the issue defies such an approach. The desire to compensate for the loss of course sediment due to development (even LID), or to avoid sediment yield areas altogether (both of which have been put forth in revisions of the Revised Draft Permit) shows a misunderstanding and a wrong focus on the issue by attempting to address it at the source. The currently proposed language in Section E.3.c.(2)(b) introduces a further complication, in that its implementation must necessarily prohibit the use of land for any compatible use other than allowing erosion to occur so that the downstream system has a supply of coarse sediment. This then becomes a land use decision.

Natural areas have produced sediment as part of a natural cycle of random precipitation events, vegetative cover and burns for millennia. Urbanization introduces a sudden and sometimes dramatic change to an equilibrium that has existed for a very long time (as in Oso Creek). In almost all cases throughout the San Diego Region, the effects of urbanization have already done most of the "work" on the downstream systems, so an onsite approach to the problem is much like closing the barn door after the horse has escaped. With that consideration, attempting to identify critical sediment yield areas within most of the watersheds will be an exercise in futility, as such areas would not typically be able to provide even a fraction of the amount of course sediment required to balance sediment through downstream reaches.

Another unintended consequence of the Revised Draft Permit Provision E.3.c.(2)(b) is that it will create a new land use restriction. The way this will likely proceed is that "critical sediment yield areas" will be identified by studying the watersheds (through the Watershed Management Area Analyses). Specifically, Copermittees will be required to prepare sediment yield studies of watersheds based on watershed-wide models and criteria that will approximately identify these critical sediment yield areas. These analyses would then be incorporated into the Water Quality Improvement Plans for each watershed. Thus, a new category of "Environmentally Sensitive Areas" will be identified and protected. After all, there is no other compatible use of such property, not even roads, so such property will become open space.

Sediment Balance Summary

In summary, sediment balance is very complicated and requires careful study of each watershed and fluvial system to understand how best to approach the issue. Fluvial systems, to transport the same amount of incoming sediment to downstream reaches, and eventually to the ocean, must often be modified. Many such systems are already modified, either as part of a natural process (degradation) or as the result of man-made modification. Attempts to address sediment balance through a directive within a permit will almost always fail; the complexity of the issue defies such an approach. The desire to compensate for the loss of coarse sediment due to development (even LID), or to avoid sediment yield areas altogether (both of which have been put forth in revisions of the Revised Draft Permit) shows a misunderstanding and a wrong focus on the issue by attempting to address it at the source. The currently proposed language in Section E.3.c.(2)(b) of the Revised Draft Permit introduces a further complication, in that its implementation must necessarily prohibit the use of land for any compatible use other than allowing erosion to occur so that the downstream system has a supply of coarse sediment. This then becomes a land use decision. The best focus for this issue remains the water bodies themselves on a watershed by watershed and reach by reach basis.

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