To: **Tom Dalziel**

From: Dan Cloak

Subject: **Proposed enhancements to Provision C.3.d**

Date: 3 February 2006

Introduction

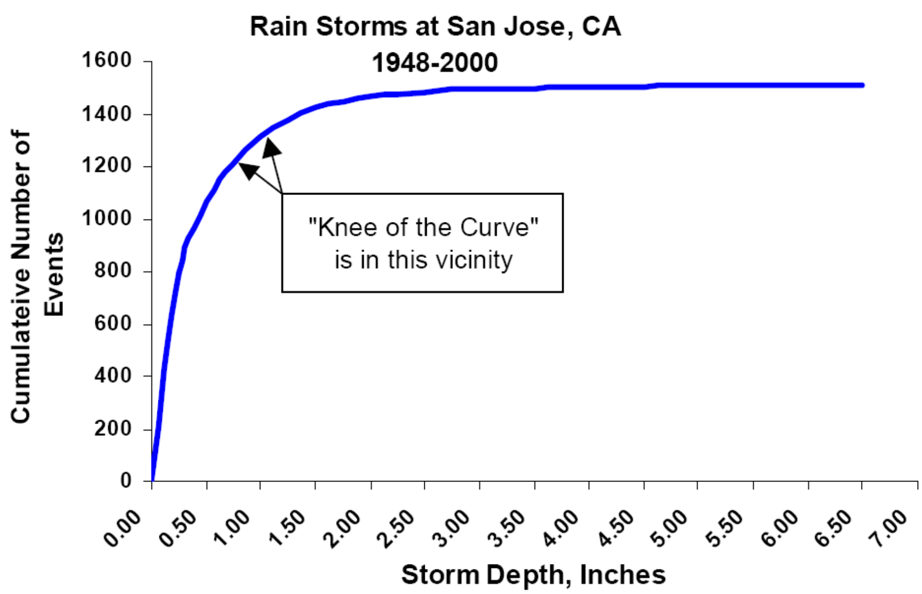
Two changes are proposed to Provision C.3.d. The changes are intended to clarify the intent of the provision, facilitate its implementation, and to promote innovation in stormwater treatment methods. The changes:

1. Add general hydraulic sizing design criteria
2. Clarify allowance for dispersion and infiltration of runoff

Add general hydraulic sizing design criteria

This proposed change clarifies the intent of the hydraulic sizing design criteria and allows application of equivalent criteria which achieve the same result.

The existing hydraulic sizing design criteria are based on the “knee of the curve” concept for defining MEP.

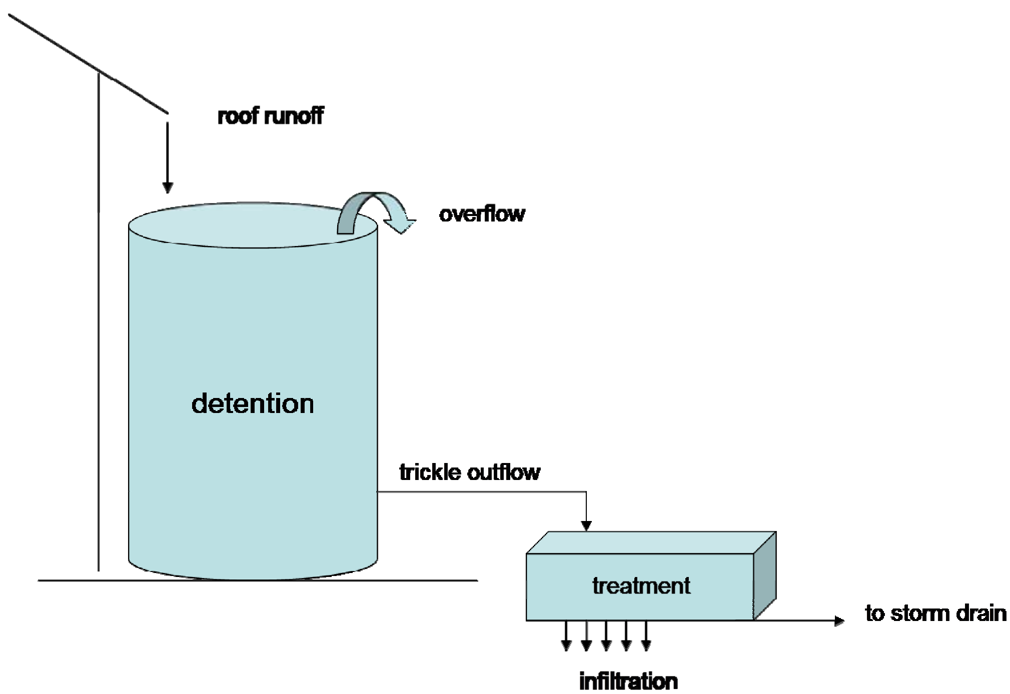


This concept is described on pages 5-12 through 5-15 of the *California Stormwater Quality BMP Handbook for New Development.*

The existing C.3.d design criteria were created by examining long-term (30 years or more) hourly rainfall records to find the "knee of the curve." The volume-based criteria are derived from a continuous simulation of rainfall, runoff, and filling/emptying of a detention basin. The sizing charts are configured so that a detention basin will capture 80% of total runoff during the period of simulation and provide the 48-hour detention time needed for effective settling of stormwater pollutants.

The flow-based criteria were derived from a ranking of storms by hourly rainfall intensity. Based on the "knee of the curve," the 85th percentile storm was selected. The other two "flow-based" criteria are roughly equivalent.

The need for the proposed change arises from the following problem: Consider a stormwater treatment system that detains stormwater peak flows and then treats those flows by trickling through a filter. An example would be a cistern which captures roof runoff and then discharges it slowly to a bioretention area.



The engineer needs a way to show the intended proportion of total runoff will be treated by this system. Over a long period of time, at least 80% should be detained and treated, and no more than 20% allowed to overflow.

The size of the detention and treatment facilities are interrelated. With a larger cistern, the orifice controlling the trickle flow, and the bioretention area receiving the trickle flow, can be smaller. Alternatively, with a larger bioretention area, the cistern can be made to empty faster, so the cistern can be smaller.

An identical issue arises if an engineer desires to account for the effect of runoff pooling to various depths on the surface when sizing a planter box, swale, or bioretention area.

Neither the existing flow-based criterion nor the existing volume-based criterion can be used to size such a system. It doesn't help to say the sizing should be "equivalent" to those criteria. A more general criterion is needed.

There are two possible ways to define such a criterion: the design storm approach and the continuous simulation approach.

With a design storm approach, the engineer would use the specified design storm to develop a hydrograph, and would use a routing algorithm and a spreadsheet to calculate the depth in the cistern and the flow through the bioretention area at hourly intervals during the storm. The engineer would play with the size of the cistern and bioretention area to obtain a combination which would successfully process 80% of the total runoff, while letting no more than 20% overflow the cistern.

The shortcomings of the design storm approach are: It doesn't account for antecedent conditions (i.e. the cistern may still be partially full from a previous storm), and patterns of rainfall are in reality much more variable and complex.

A continuous simulation approach overcomes these limitations by simulating all runoff over 30 years or more instead of just one design storm. Most stormwater programs have compiled and verified suitable hourly rainfall records.

Fortunately, the required change in Provision C.3.d is very simple. By adding the words "or equivalent criteria to achieve treatment of 80% of runoff over the life of the project," the Provision would enable a designer to show, through output of a continuous simulation, that the facility is adequately sized. Unlike the existing volume-based and flow-based criteria, this criterion can be applied to systems of just about any complexity.

Clarify allowance for dispersion and infiltration of runoff

In the Order adding Contra Costa's C.3 Provisions, Finding 11 states:

> The Dischargers have encouraged developers to minimize increases in impervious surfaces through a number of techniques such as those described in the Bay Area Stormwater Management Agencies Association's (BASMAA's) "Start at the Source Design Guidance Manual for Stormwater Quality Protection," 1999 edition (Start at the Source). One of the techniques recommended by Start at the Source is to use permeable pavements to infiltrate stormwater while still providing a stable load-bearing surface. For purposes of this Order, the Program may submit guidelines for use of these techniques for minimizing increases in impervious surfaces described in Start at the Source, implementation of which will provide that such areas will not count toward the creation or replacement of impervious surfaces, or may be modeled differently for the purposes of sizing post-

> construction stormwater treatment controls, for approval by the Executive Officer.

Finding 15 states in part:

> Further, revision of standards and guidance can allow implementation of site design measures in projects to meet or help meet the numeric sizing criteria in Provision C.3.d and/or the hydrograph modification limitation in Provision C.3.f.

Provision C.3.b requires

> … a project proponent to implement site design/landscape characteristics where feasible which maximize infiltration (where appropriate), provide retention or detention, slow runoff, and minimize impervious land coverage, so that post-development pollutant loads from a site have been reduced to the maximum extent practicable…

However, Provision C.3.d provides no reference to these practices and no criterion for determining when and how they may be used, in conjunction with stormwater treatment, to reduce pollutant loads.

BASMAA's 1999 *Start at the Source* design manual promotes methods to reduce site imperviousness, and BASMAA's 2003 *Using Site Design Techniques to Meet Development Standards for Water Quality* provides guidance for removing "zero discharge areas" and "self-treating areas" from the calculation of required water quality volumes.

Adding the words "or measures to disperse and infiltrate runoff from impervious areas" to Provision C.3.d would make the provision consistent with and complementary to Provision C.3.b and the Board's findings. In addition, this change clarifies that reducing imperviousness and directly connected impervious area may be used as a design strategy to reduce the number and size of treatment facilities required.

Proposed changes to Provision C.3.d in redline/strikeout

Provision C.3.d
Numeric Sizing Criteria For Pollutant Removal Treatment Systems:

All Dischargers shall require that treatment measures, or measures to disperse and infiltrate runoff from impervious areas, be constructed for applicable projects, as defined in Provision C.3.c, that incorporate, at a minimum, the following hydraulic sizing design criteria or equivalent criteria to achieve treatment of 80% of total runoff over the life of the project. ~~to treat stormwater runoff.~~ As appropriate for each criterion, the Dischargers shall use or appropriately analyze local rainfall data to be used for that criterion.

i. Volume Hydraulic Design Basis: Treatment measures whose primary mode of action depends on volume capacity, such as detention/retention units or infiltration structures, shall be designed to treat stormwater runoff equal to:

1. The maximized stormwater capture volume for the area, based on historical rainfall records, determined using the formula and volume capture coefficients set forth in *Urban Runoff Quality Management, WEF Manual of Practice No. 23/ ASCE Manual of Practice No. 87, (1998)*, pages 175-178 (e.g., approximately the 85th percentile 24-hour storm runoff event); or

2. The volume of annual runoff required to achieve 80 percent or more capture, determined in accordance with the methodology set forth in Appendix D of the *California Stormwater Best Management Practices New Development Handbook (CASQA~~,~~ (~~1993~~2003)*, using local rainfall data.

ii. Flow Hydraulic Design Basis: Treatment measures whose primary mode of action depends on flow capacity, such as swales, sand filters, or wetlands, shall be sized to treat:

1. 10% of the 50-year peak flow rate; or
2. The flow of runoff produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity for the applicable area, based on historical records of hourly rainfall depths; or
3. The flow of runoff resulting from a rain event equal to at least 0.2 inches per hour intensity.