Hydromodification and the Role of Low Impact Development

SDHF's 17th Annual Affordable Housing & Community Development Conference

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URS

Presentation Agenda

- Hydromodification
  - What is Hydromodification?
  - What Does it Look Like?
  - What Causes Hydromodification?
- Current and Pending Permit Requirements
- What is Expected…LID

What is Hydromodification?

- Change in the natural watershed hydrologic processes and runoff characteristics
  - Interception
  - Infiltration
  - Overland flow
  - Interflow
  - Groundwater flow
- Alteration of stream and river channels
- Installation of instream dams and water impoundments
- Excessive streambank and shoreline erosion

What Does it Look Like?

What Does it Look Like?

What Does it Look Like?

What Does it Look Like?

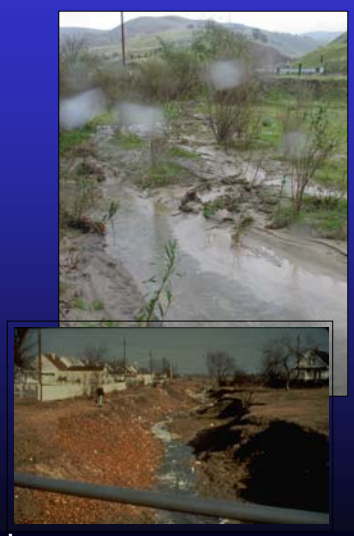
What Does it Look Like?

What Causes Hydromodification?

- Increases in the frequency and duration of runoff as a result of watershed development
  - Added impermeable area
  - Higher drainage density
  - More efficient channel network
- Flow increases can cause or accelerate erosion of stream bed and/or bank

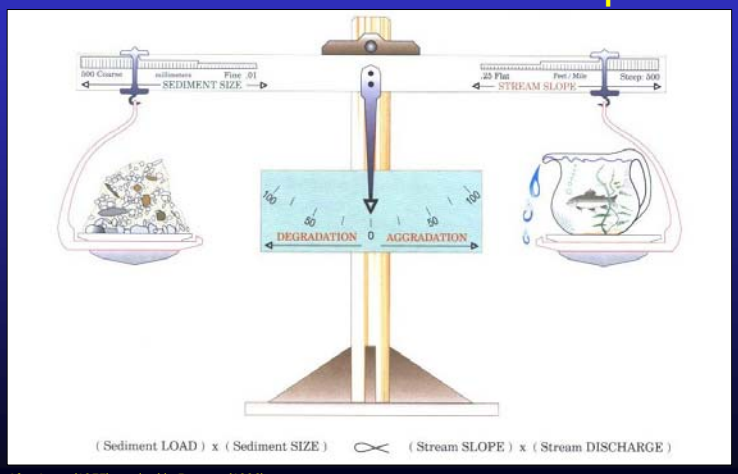
What Causes Hydromodification?

- Construction – Sediment load increases and leads to aggradation
  - Stream depths may decrease
    - Decreased channel capacity
    - Increased flooding
    - Increased overbank deposition
- Post-Construction – Increased flows lead to degradation
  - Eroded channels (deepened and widened)
  - Channels Narrow (sediment from incision deposits laterally)
  - Sediment size is altered
    - Less fine sediment
    - Increased course sand
    - Decreased gravel
  - Increased channel slope
  - Increased velocities
  - Increased sediment transport within channel



What Causes Hydromodification?

Schematic of the Lane Relationship



After Lane (1955) as cited in Rosgen (1996)

Presentation Agenda

- Hydromodification
- Current and Pending Permit Requirements
  - San Diego MS4 Permit
  - Preliminary Draft Construction General Permit
- What is Expected…LID

Current and Pending Permit Requirements

Construction General Permit Requirements Not Applicable to MS4-Permitted Areas

All Other Areas Must Comply General Construction Permit Requirements

Preliminary Draft CGP Section VIII.H

San Diego MS4 Permit Requirements

Limitations on Increases of Runoff Discharge Rates and Duration:

- Post-project runoff discharge rates and durations ≤ pre-project discharge rates and durations where increased rates potentially cause erosion and impacts to beneficial uses

San Diego MS4 Permit Section D.1.g

San Diego MS4 Permit Requirements

Limitations on Increases of Runoff Discharge Rates and Duration:

- Non-naturally occurring hardscape materials can not be used to address changes to channels
- HMP control measures do not apply to Priority Projects that discharge to downstream channels and storm drains that have minimal erosion potential or other beneficial use impacts
  - Concrete-lined or significantly hardened (e.g., with rip-rap, sackrete, etc.) downstream to their outfall in bays or the ocean;
  - Underground storm drains discharging to bays or the ocean; and
  - Construction of 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.

San Diego MS4 Permit Section D.1.g

San Diego MS4 Permit Requirements

Interim Hydromodification Criteria for Projects 50 Acres or More:

- Copermittees must develop interim range of flow rates and durations where increased rates and durations will potentially cause erosion and impacts to beneficial uses
- Priority projects must implement controls to control rates and durations

San Diego MS4 Permit Section D.1.g

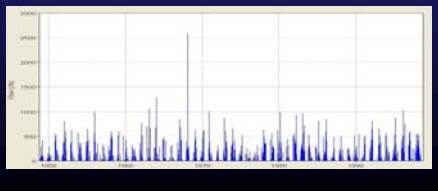
HMP Schedule

Tasks	Tentative Order	SCCWRP Project
Adoption by Regional Board	January 24, 2007	----------
Advertise Request for Proposal for Consultant	early Spring 2007	
Consultant Contract awarded	Summer 2007	February 2007
Convene Technical Advisory Committee	Summer 2007	March 2007
Literature Review Update	Fall 2007	Unknown
Protocols for channel mapping and classification	Summer 2008	Summer 2007
Protocol for channel standard	Summer 2008	----------
Interim HMP	March 24, 2008*	----------
Submit Progress Report to Regional Board	July 24, 2008	----------
Protocols for regional monitoring/assessment	Winter 2008	Winter 2008
Screening Tools	Fall 2008	Fall 2008
Submit Draft HMP to Regional Board	January 24, 2009	----------
Dynamic Simulation Tools	Summer 2009	Summer 2009
Management Tools	Fall 2009	Fall 2009
Outreach	90 days after Regional Board approval	Winter 2010

* Originally scheduled for implementation on January 24, 2008. The deadline was extended by two months due to October 2007 firestorm in San Diego region.

MS4 Permit Requires Use of Continuous Simulation Model

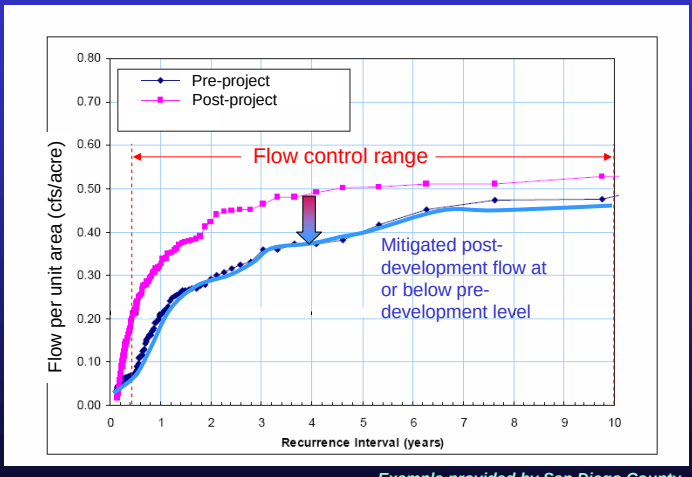
- Erosion is largely due to the cumulative affects of small flows
- Must compare pre- and post-project hydrology to identify impacts across range of flows
- Modeling Software
  - Hydrologic Simulation Program – FORTRAN (HSPF), distributed by EPA
  - Hydrologic Modeling System (HEC-HMS), distributed by ACOE
  - Third-party software receiving review by Copermittees



Modeling Process

- Select appropriate historical precipitation dataset for the analysis…provided by County or Jurisdiction NPDES Coordinator
- Develop a model to represent the pre-project conditions, including
  - Land cover types
  - Soil characteristics
  - General drainage direction and slope
- Develop a model to represent the post-project conditions, including
  - New land cover types – more impervious surfaces
  - Soil characteristics
  - Any modifications to the drainage layout
- Examine the model results to determine how the proposed development affects storm water flows
  - Compute peak flow recurrence statistics
  - Compute flow duration series statistics
- Iteratively size storm water control facilities until the post-project peak flows and durations meet the performance standards

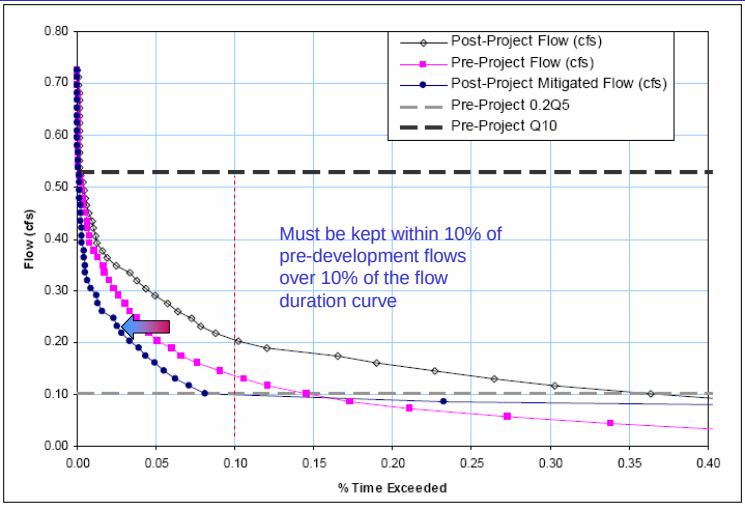
Must Control Significant Peak Flow Recurrence



Example provided by San Diego County

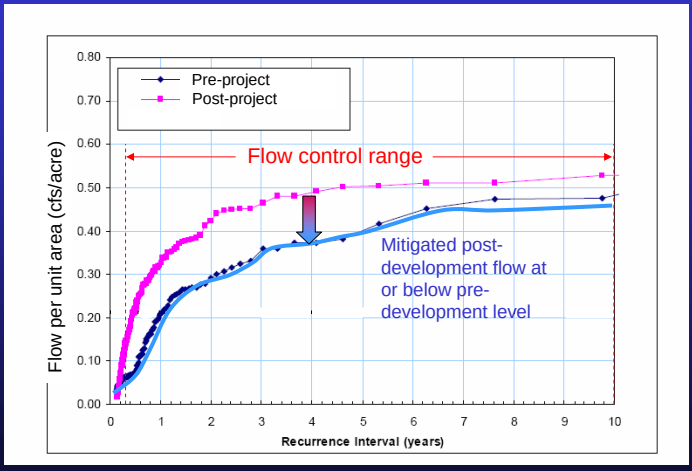
Interim Flow Control Standard: 0.2Q5 to Q10 kept within 10% of pre-development flows over 10% of flow duration curve

Must Control Flow Duration Exceedances



Example provided by San Diego County

Must Control Significant Peak Flow Recurrence



Example provided by San Diego County

HMP Proposed Flow Control Standard: 0.1Q2 to Q10

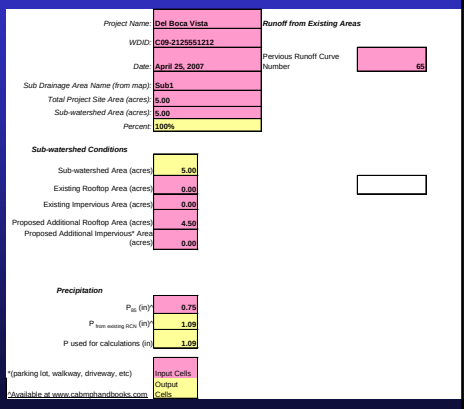
Preliminary Draft Construction General Permit Requirements

- **Replicate pre-project water balance**
  - Rainfall that ends up as runoff for the smallest storms up to the 85th percentile storm event or the smallest storm event that generates runoff, whichever is larger
- **Use structural and non-structural controls**
- **Structural controls require RWQCB approval**
- **For projects with DSA > 2 acres:**
  - Preserve pre-construction drainage density (miles of stream length per square mile of drainage area) for all drainage areas serving a first order stream (i.e., stream with no tributaries) or larger stream
  - Ensure Post-Project $T_c \geq$ Pre-Project T_c

Preliminary Draft CGP Section VIII.H

Preliminary Draft Construction General Permit Requirements

- **Submit with NOI and NOT**
- **Map**
  - Existing contours
  - Pre- and post-construction drainage divides
  - Total stream length in each watershed
  - Scales – 1 in. = 20', 30', 40' or 50'
  - 1' to 5' contour intervals
- **Worksheets in accordance with Attachment F**
  - SWRCB "Volume calculator.xls", SWMM, or HSPF
  - Complete for each sub-drain area



Project Name:	Del Boca Vista
WDID:	C09-2125551212
Date:	April 25, 2007
Sub Drainage Area Name (from map):	Sub1
Total Project Site Area (acres):	5.00
Sub-watershed Area (acres):	5.00
Percent:	100%

Runoff from Existing Areas

Pervious Runoff Curve Number: 65

Sub-watershed Conditions

Sub-watershed Area (acres):	5.00
Existing Rooftop Area (acres):	0.00
Existing Impervious Area (acres):	0.00
Proposed Additional Rooftop Area (acres):	4.50
Proposed Additional Impervious* Area (acres):	0.00

Precipitation

P_{85} (in)*	0.75
$P_{\text{from existing RCN}}$ (in)*	1.09
P used for calculations (in):	1.09

*(parking lot, walkway, driveway, etc)

Input Cells
Output Cells

*Available at www.cabmphandbooks.com

Preliminary Draft CGP Attachment F

Presentation Agenda

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- **What is Expected…LID**

What is Expected…LID

LID Site Design BMPs – All Priority Development Projects

i. Drain impervious areas to pervious areas – runoff volume to correspond to pervious area's capacity to infiltrate/treat
ii. Design and construct pervious area to effectively receive, infiltrate/treat
iii. Construct portions of low traffic areas (pedestrian and vehicular) with permeable surfaces

San Diego MS4 Permit Section D.1.d.(4)(a)

What is Expected…LID

Additional LID BMPs – All Priority Development Projects where applicable and feasible

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

San Diego MS4 Permit Section D.1.g

What is Expected…LID

- Non-Structural Practices Available for Crediting
  - *Porous Pavement*
  - *Tree Planting*
  - *Downspout Disconnection*
  - *Impervious Area Disconnection*
  - *Stream Buffer*
  - *Vegetated Swales*
  - *Rain Barrels and Cisterns*
  - *Soil Quality*

Preliminary Draft CGP Attachment F