Practical Application of Modeling Results to Land Development Policies in Contra Costa County

California Water Environmental Modeling Forum Watershed and Urban Hydrology Modeling Workshop 22 June 2007

Dan Cloak Environmental Consulting

Topics

Stormwater NPDES requirements Low Impact Development Model approach and features Using results for LID design **Enhancements in progress**

NPDES requirements for new developments Minimize imperviousness Control pollutant sources Treat stormwater prior to discharge from the site Match peaks and durations to pre-project conditions (HMP) Maintain treatment and flowcontrol facilities in perpetuity



Low Impact Development

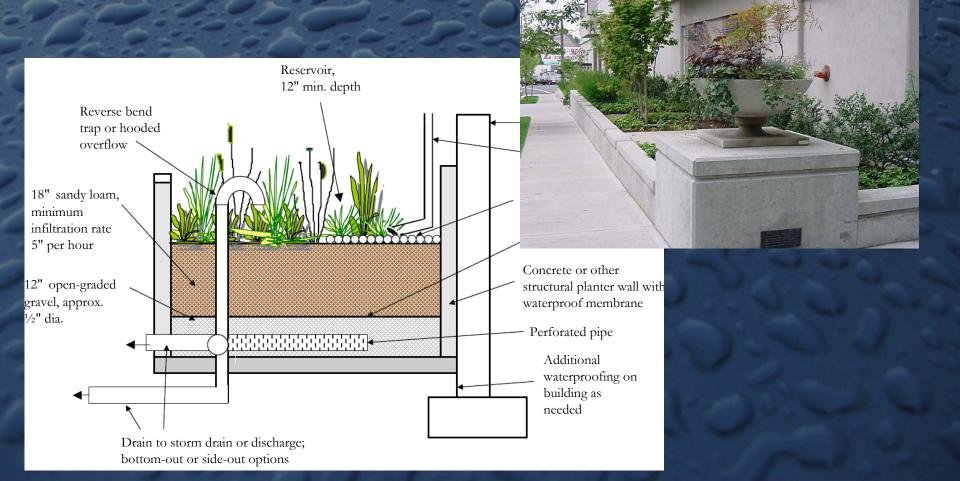
Stormwater treatment and flow control Minimize imperviousness Disperse runoff Use Integrated **Management Practices** (IMPs)



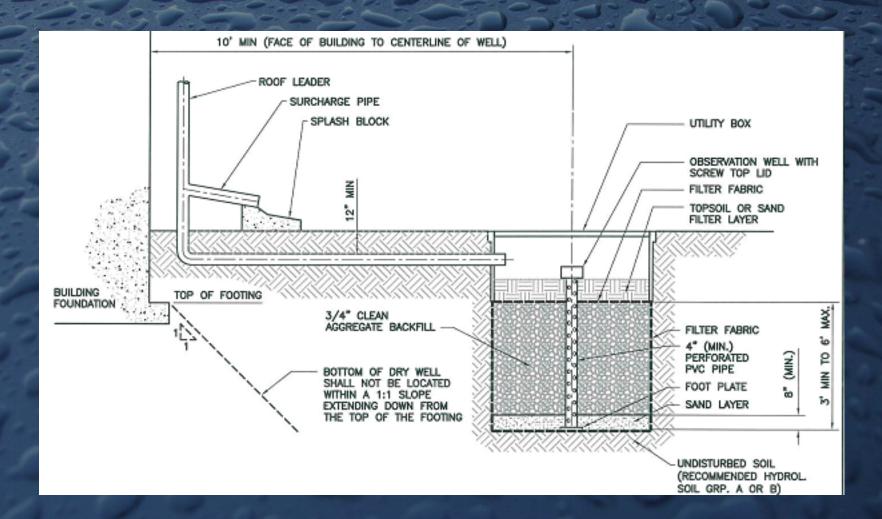




Planter Box

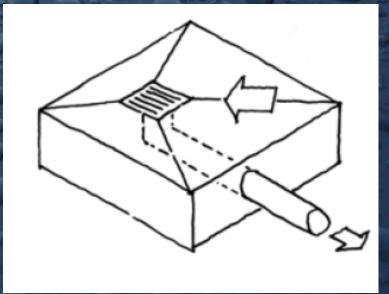


Dry Well



Showing Treatment Compliance

NPDES Permit sizing criteria for treatment control: "collect and convey" drainage design conventional, "end of pipe" treatment ■ use of "C" factors to determine design inflow or volume



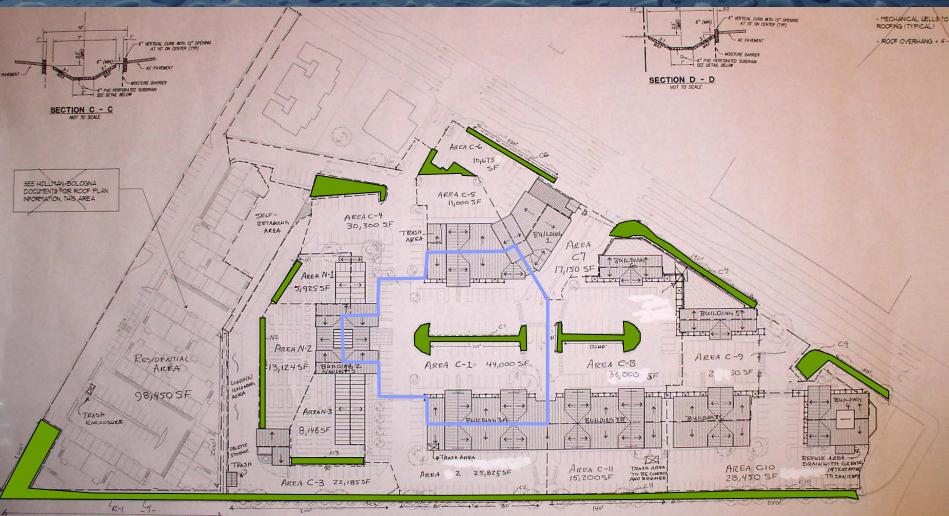
Sizing criterion for treatment



BMP Area/Impervious Area = 0.2/5 = 0.04

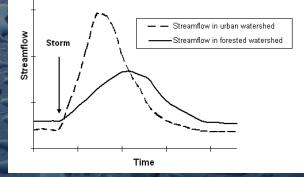


Application of sizing factor



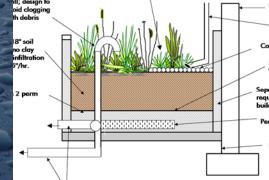
280'

LID for flow control



 Can LID facilities mitigate increased peaks and volumes of flows from impervious areas?
 How would we demonstrate that?
 What are the design criteria?

Who needs a model?



Needed: A conservative "best guess" for appropriate sizing factors Proposed solution: Implied equivalence to pre-project condition by Weighted "C" (rational method) Curve number (NRCS) $\blacksquare \Delta S$ (initial storage in NRCS) Any other values for input parameters to a hydrologic model **However:** Water Board staff specified continuous simulation

HSPF analysis of unit-acre runoff

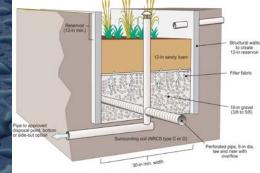
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to create 12-in reserve

18-in grave (3/8 to 5/8)

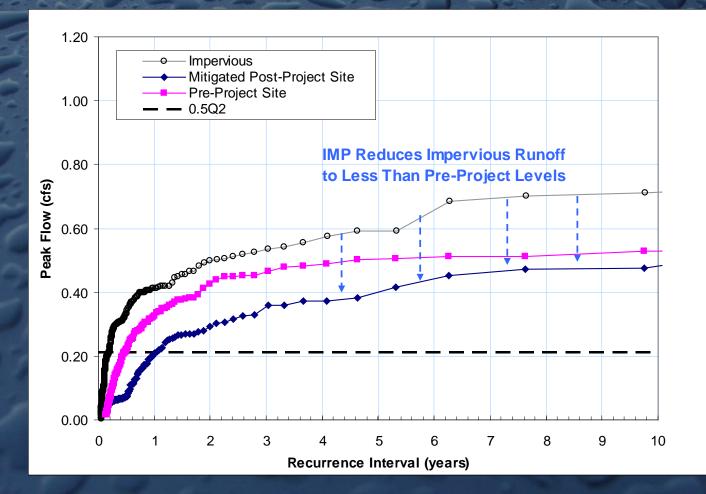
33 years hourly rainfall 2-in sandy loam Pre-project condition 100% impervious condition Perforated pipe, 6-in dia lee and riser with Section not to scale Hydrologic soil groups A, B, C, D Swales, Bioretention Areas, **In-ground and Flow-through Planters** Underdrain with flow-restrictor in C&D soils Dry wells, infiltration trenches and basins

Modeling Approaches

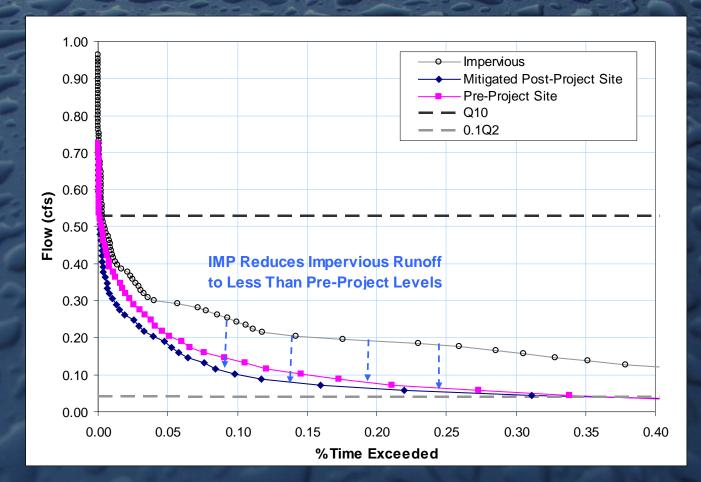


"Bathtub" approach Pervious land surface over gravel Two-layer approach Stage-storage discharge relationships represented in FTABLEs. Soil moisture content recalculated at each time step Matric head within soil pores and hydraulic conductivity recalculated for each time step

Results: Control of Peak Flows



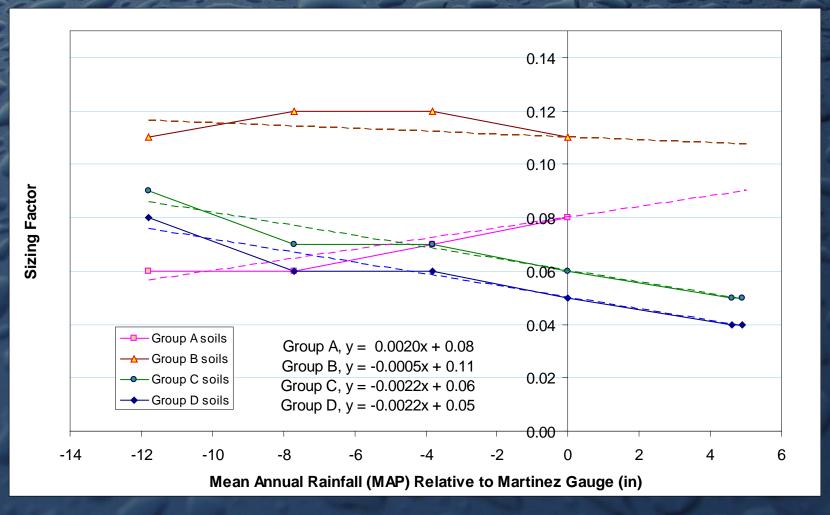
Results: Flow Duration Control



Sizing Factors for Flow Control

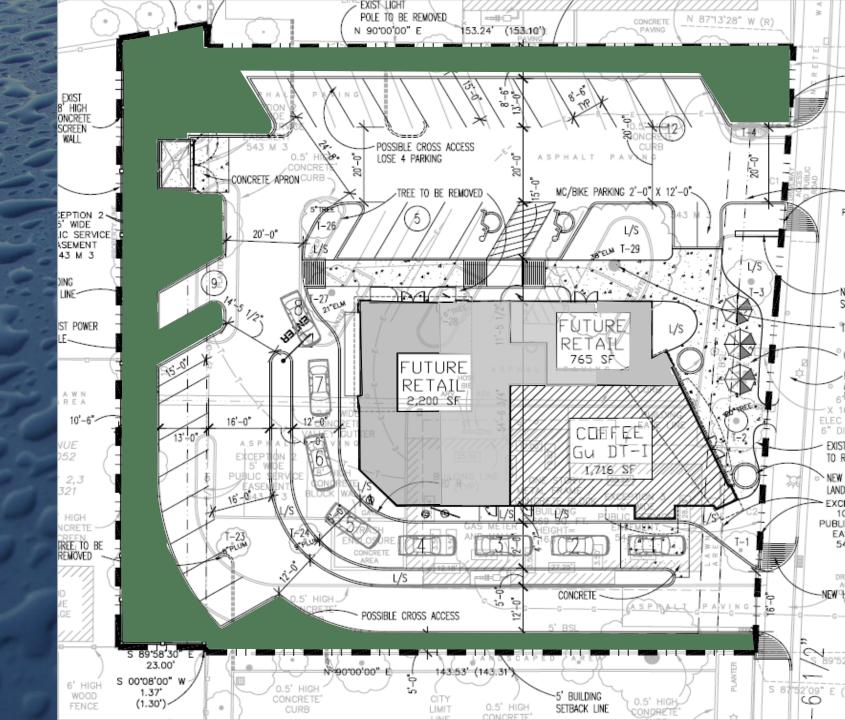
IMP	Sizing Factors		IMP	Sizing Factors
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Flow- Through Planter	Group C: 0.06 Group D: 0.05	Not to	Infiltration Trench	Group A: 0.05 to 0.06 Group B: 0.07 to 0.10
Vegetated/ Grassy Swale	Group A: 0.10 to 0.14 Group B: 0.14 to 0.21 Group C: 0.10 to 0.15 Group D: 0.07 to 0.12		Infiltration Basin	Group A: 0.05 to 0.10 Group B: 0.06 to 0.16
Bioretention Basin	Group A: 0.13 Group B: 0.15 Group C: 0.08 Group D: 0.06		200	No con

Adjustment to annual rainfall



Using LID with Sizing Factors

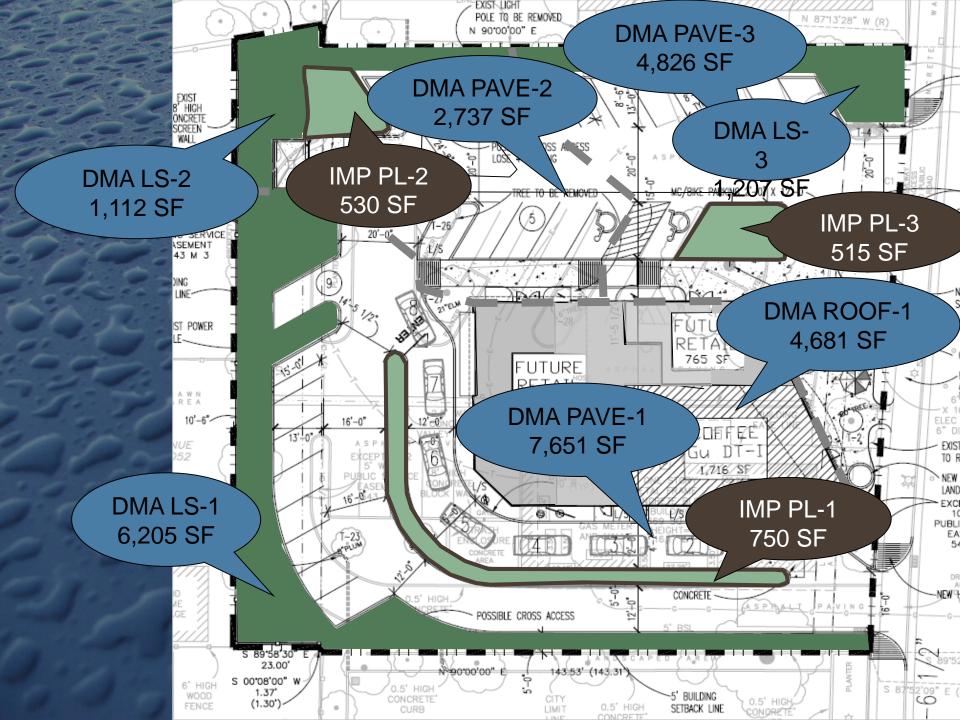
Step-by-step instructions Intuitive interface Can be used by developer's designer (engineer, architect, or tech) Demonstrates compliance with both treatment and flow-control requirements



369 South Winchester Blvd, San Jose, CA

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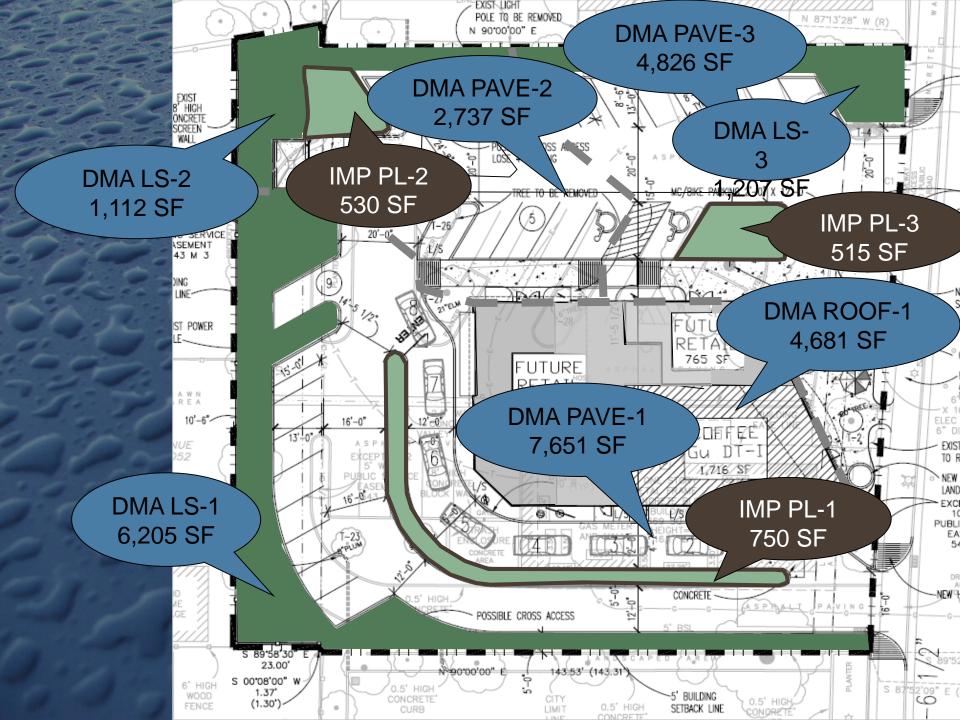
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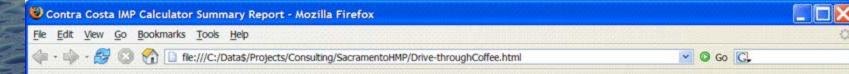
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Project Name: Drive-Through Coffee Shop Project Type: Flow Control and Water Quality Location: Anytown, USA APN: 000-0000-000 Drainage Area: 28330 (sf) Mean Annual Precipitation: 15 (in)

Drainage Management Areas Draining to IMPs

				IM	P						Т	ributa	ary DMA	As	
Name	Туре	Soil Group	Rain Adj. Factor	Eastor				Planned Size	Max Underdrain Flow (cfs)	Name	Surface Type	Area	Runoff Factor	Min IMP Size	Contribution to Max Underdrain Flow (cfs)
PL-3	In-Ground (Infiltration) Planter	D	1.23	0.05		-	282 sq ft	300 sq ft	0.0056	PAVE-3	Conventional Concrete or Asphalt Paving	4576	1	282	
PL-1	In-Ground (Infiltration) Planter	D	1.23	0.05	-		738 sq ft	750 sq ft	0.0147	PAVE-1	Conventional Concrete or Asphalt Paving	7311	1	450	
										ROOF-1	Roofs	4681	1	288	-
PL-2	In-Ground (Infiltration) Planter	D	1.23	0.05			155 sq ft	220 sq ft	0.0031	PAVE-2	Conventional Concrete or Asphalt Paving	2517	1	155	-

How "real" are sizing factors?

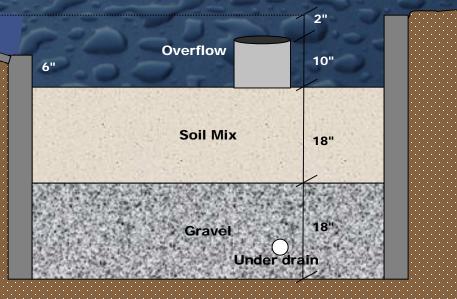
Applied a model intended for watershed scale to site scale Sizing factors are minimums, facilities are actually built larger Used textbook or countywide values for input parameters Didn't account for losses or inefficiencies in drainage systems

Next: Improved IMPs

Abating the drop-off problem



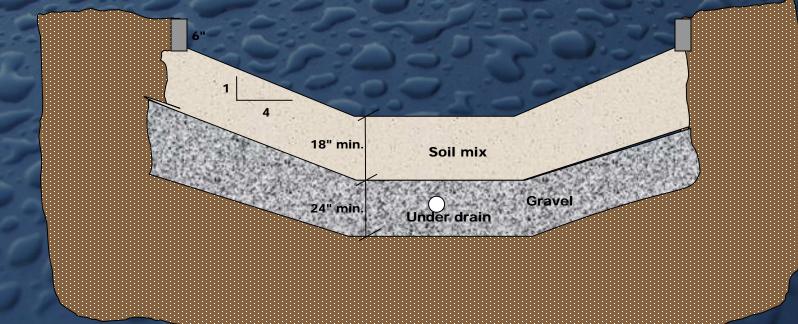
Floodable pavement



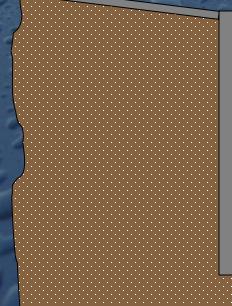
Cistern and bioretention

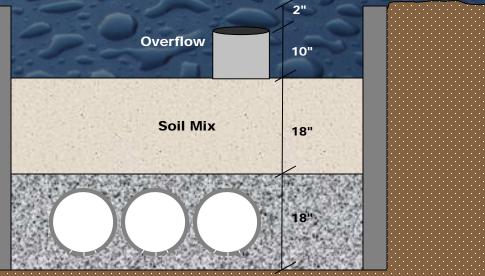


Enhanced swale section



Enhanced underground storage





Conclusions

Design criteria for stormwater facilities are always "best professional judgment." Modeling provides some insights, but perhaps just as many illusions. More useful insights come from observations and tinkering. That requires building and operating many facilities over a long period.