TETRA TECH

Hydromodification Software Review

County of San Diego

August 1, 2011

The Bottom Line

- Sizing Calculator: Consistent with the HMP
  - Easy to use (and review)
  - Minor adjustments to assumptions may be needed
  - Not fully applicable to large/complex sites
- Clear Creek SDHM2011: Generally acceptable
  - Compatible with Sizing Calculator assumptions
  - Flexible; allows evaluation of large/complex sites
  - Requires larger level of effort to use and review

Review Process

- Brown & Caldwell provided access to Sizing Calculator and documentation, including background HSPF files
- Clear Creek Solutions provided review copy of SDHM2011 and assisted with installation and debugging
- Tetra Tech undertook a variety of comparison evaluations and stress tests to evaluate tools

Differences in Philosophy

- Both approaches address HMP requirements of matching pre-development flow across a specified range
- Brown & Caldwell implemented HSPF model runs in the background to develop generic sizing factors for BMP/soil/slope combinations
- SDHM allows the user to set up a site-specific HSPF model, run it for multiple years with and without BMPs, and analyze results

Underlying HSPF Model

- Nearly identical…
- Brown & Caldwell parameters taken largely from early SDHM
- SDHM2011 appears to try to ensure consistency with Brown & Caldwell
- Differ in lower zone ET parameter
  - B&C has seasonally varying table, but does not activate
  - SDHM2011 copies the table and activates it
  - Seasonal values are warranted, but difference is small

Are the HSPF Parameters Reasonable?

- Not based on calibration to San Diego conditions
- Most parameter values agree with earlier version of SDHM
- Most of those parameter values come from Clear Creek's Bay Area Hydrologic Model (Santa Clara Co.)
- Most ultimately derive from Aqua Terra calibration for Castro Valley and Alameda Crk in Alameda Co. (primarily A and D soils)

Are the HSPF Parameters Reasonable?

- Infiltration index INFILT varied by soil and slope, ranges from 0.02 on high slope D soils to 0.09 on low slope A soils
- EPA guidance: 0.01-0.05 for D soils; 0.4-1.0 for A soils
- Upper end is compressed for Alameda calibration
- May overestimate runoff from soils with high infiltration capacity

Are the HSPF Parameters Reasonable?

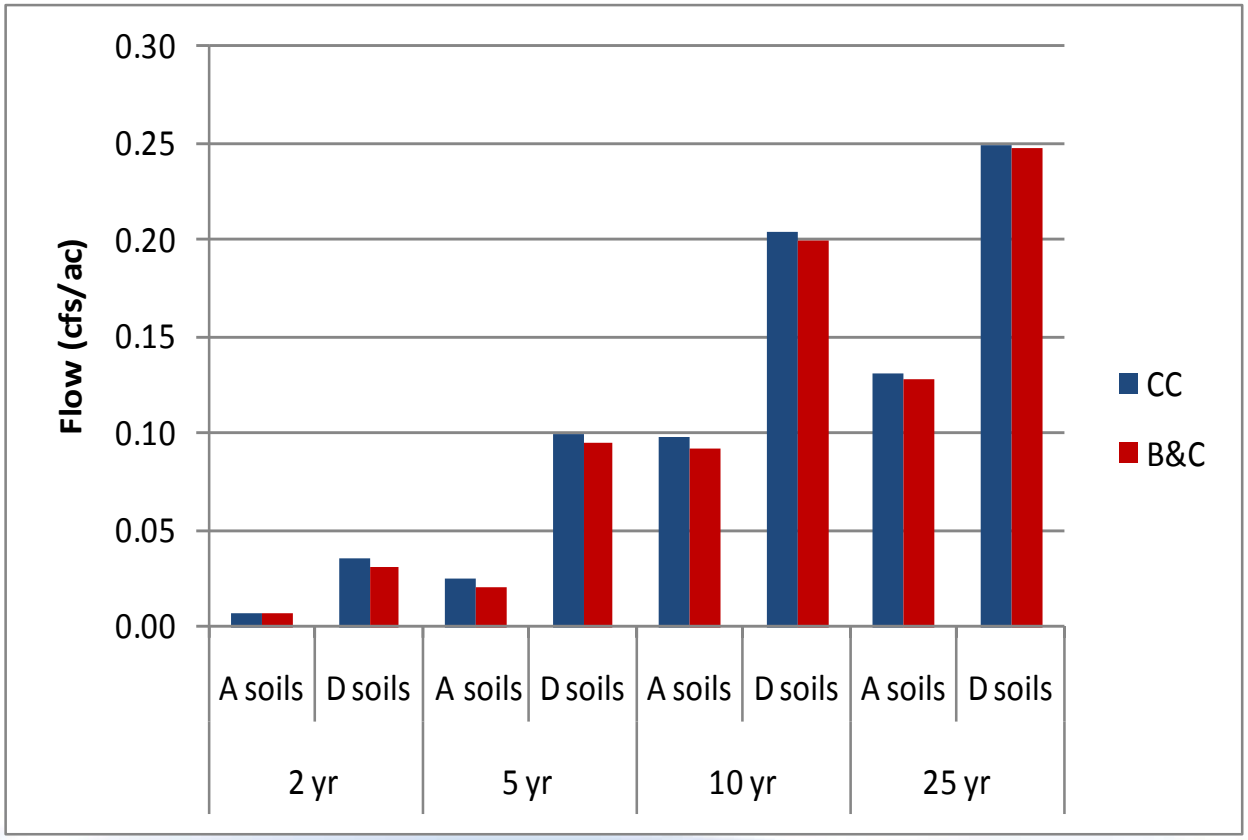
- 40% of groundwater assumed lost to deep percolation (DEEPFR) – likely too high
- This will decrease groundwater discharge and deplete the receding tail of the storm hydrograph
- Could be significant at fraction of Q2 (lower end of control range)
- Local validation of parameter set is needed

HSPF Implementation

- Models use same weather data
- SDHM adds irrigation on urban pervious land, B&C does not
- This makes a big difference in total flows
  - Reason for B&C omission not fully clear
  - SDHM assumptions are not documented
- Does not directly impact sizing factors because these assume runoff only from impervious land
- Would impact pond sizing

HSPF Pre-development Simulation

- *Nearly* identical (differ due to LZETP)

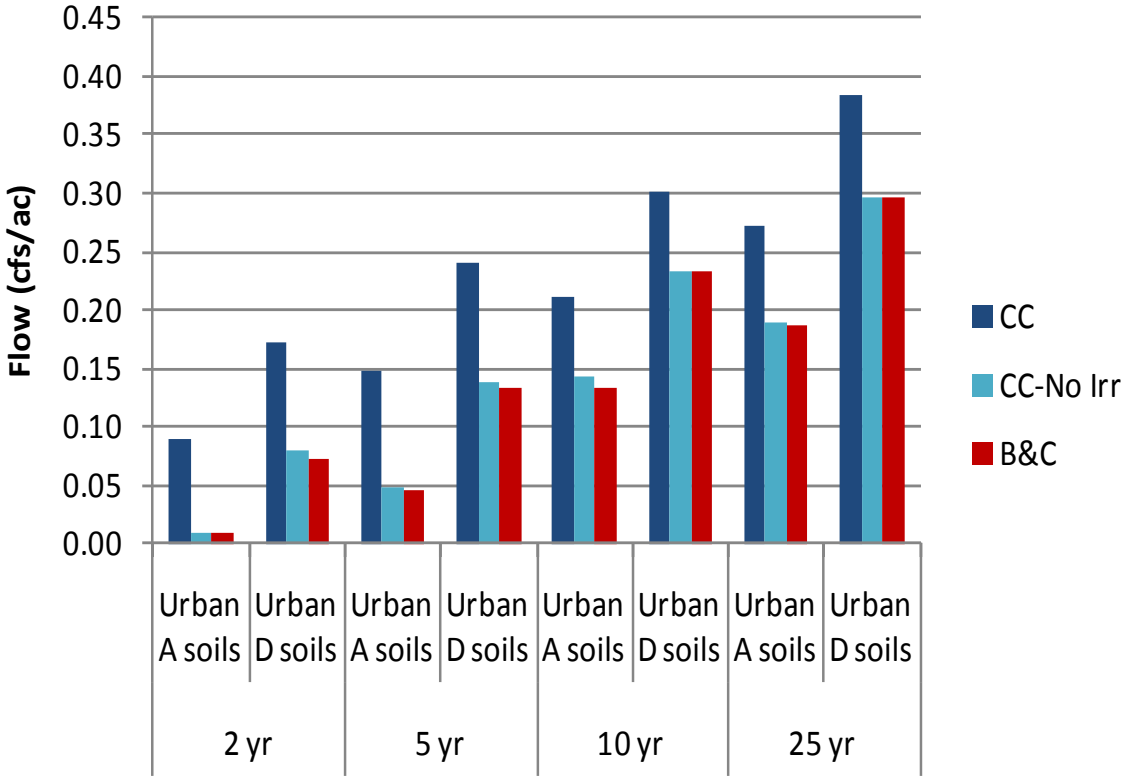


Post-development Impervious Flow

- Two models are identical

Post-development Pervious Flow

- Irrigation makes a big difference

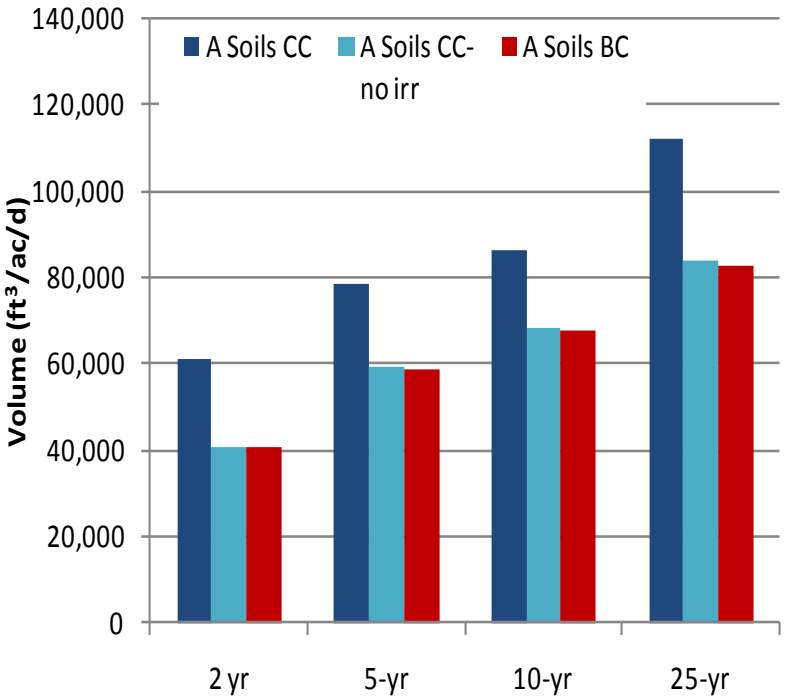


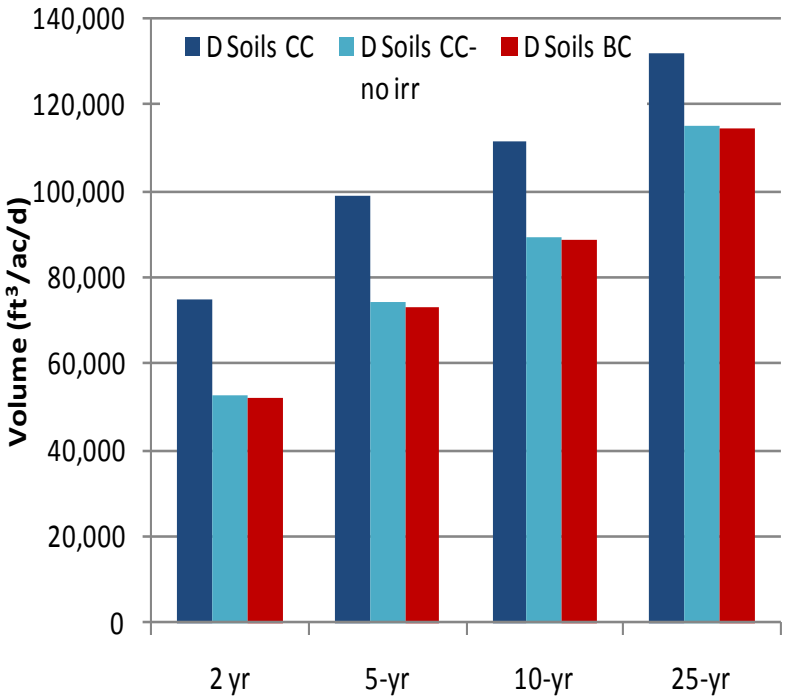
Implications for Facility Sizing

- Look at total flow from a medium density residential parcel at 30 percent impervious – not just the impervious flows
- Total volume to control is difference between post-development and pre-project flows
- SDHM has slightly higher flows both pre-project and post-development, so differences tend to cancel out

Simulated Control Volumes

- Results nearly identical – if irrigation is removed



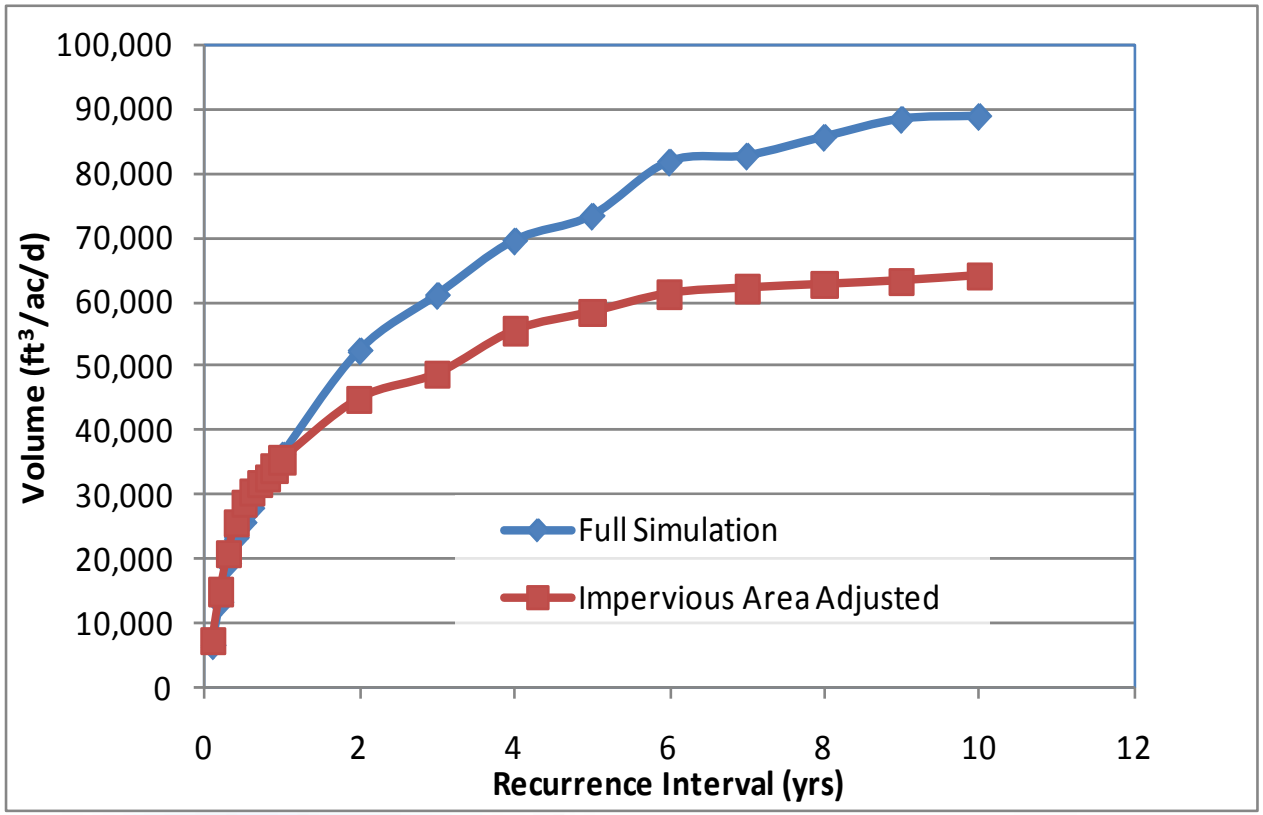


B&C Approach to Pervious Urban Land

- If pervious land is in drainage area to BMP, it's treated as producing runoff at rate of 10% of the impervious land
- This works, to a degree, but will tend to underestimate total flows during large events on soils with poor infiltration rates
- Are the SUSMP expectations that pervious areas will be improved to be "self retaining" realistic?

B&C Approach to Pervious Urban Land

- Test of "10%" assumption on D soils, 70% pervious



Simulation of BMPs

- Largely similar – Brown & Caldwell and Clear Creek Solutions have learned from one another since the Bay Area models were developed
- Both models now incorporate the same sophisticated approach to infiltration
- Both now allow restrictive orifices on underdrains

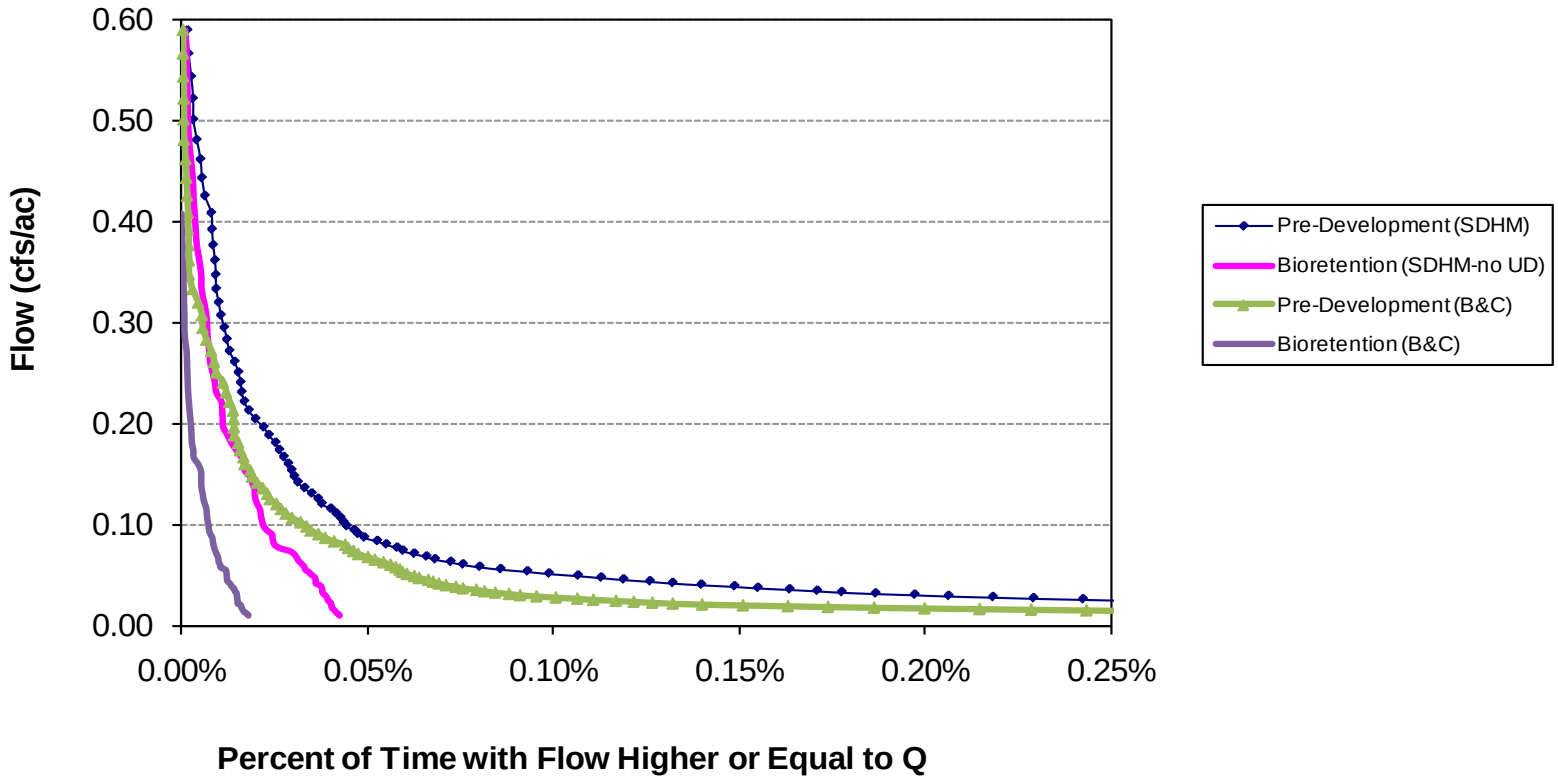
Differences in BMP Simulation

- Slight differences in hydraulics
- SDHM uses Special Actions to cap percolation rate when pore space is filled
- Evapotranspiration from LID:
  - B&C applies PET x 0.78 to surface layer only
  - SDHM applies PET x 0.5 to surface soils; x 0.7 to the subsurface layer
- SDHM contains multiple user options, does not force user to follow prescribed designs

Head to Head Comparison

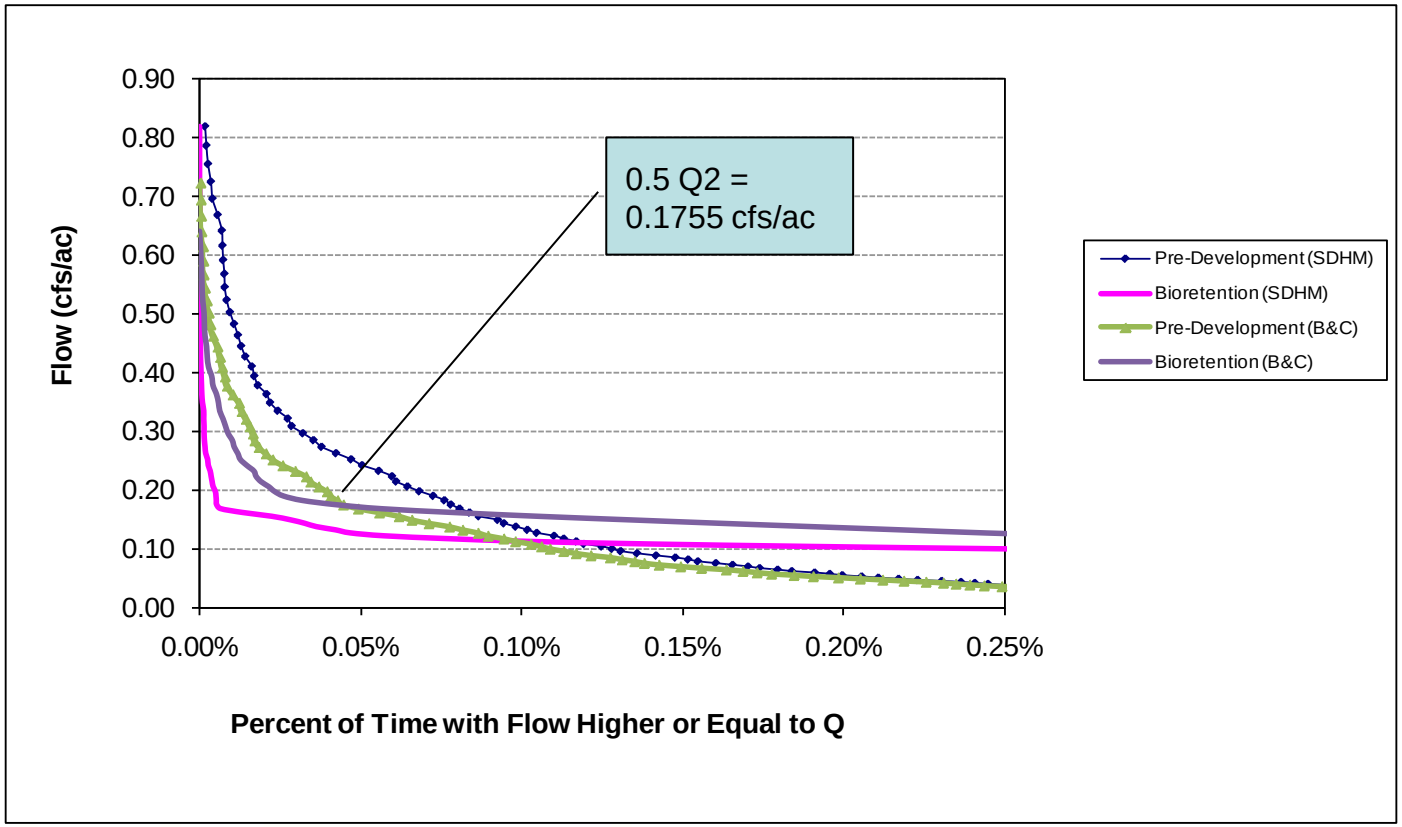
- Examine cumulative impact of differences through simulation of sample site
  - Post-development: 100% impervious
  - Pre-project: grass/scrub D steep or grass/scrub A moderate slope
  - Lake Wohlford precipitation, 1959-2004
- Bioretention tests all components of models
- Use SDHM2011 to construct a bioretention cell using Brown & Caldwell design (this takes some effort!)

Flow Durations, A Soils



Flow Durations, D Soils

- Lower control level at 0.5Q2

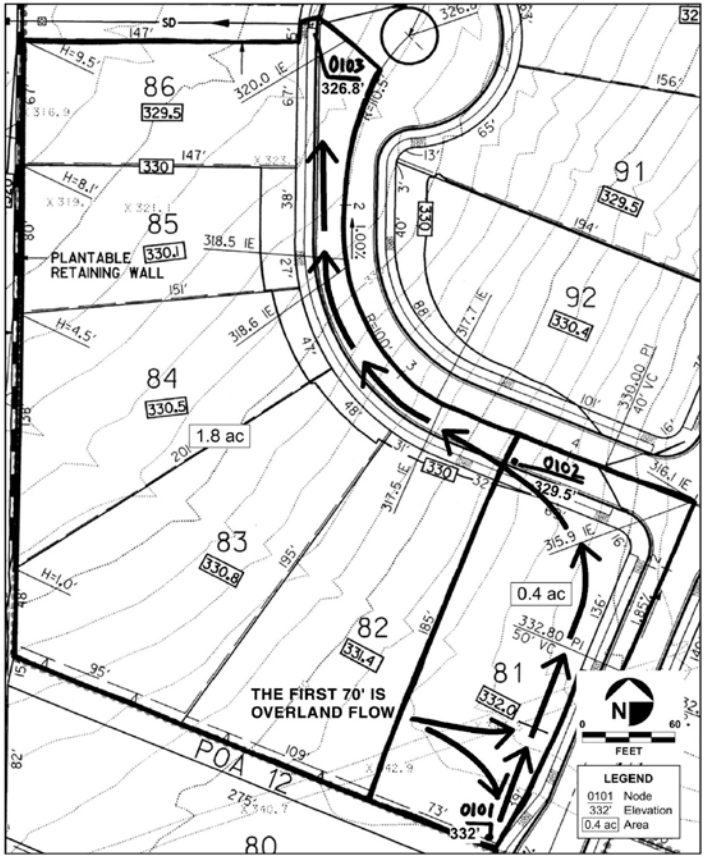


Ability to Simulate Peak Flows

- Brown & Caldwell and SDHM models both run at an hourly time step
- Typical time of concentration for runoff at the development scale is on order of 10-15 minutes
- HSPF simulations at an hourly time step CANNOT estimate instantaneous peak discharges
- Can compare peak flows at hourly duration

Peak Flow Comparison

- Compare to hourly-duration peaks from RATHYDRO – hydrograph version of Rational Method
- Use isopluvial data from the Hydrology Manual
- Rework WB.2 example from the Hydrology Manual

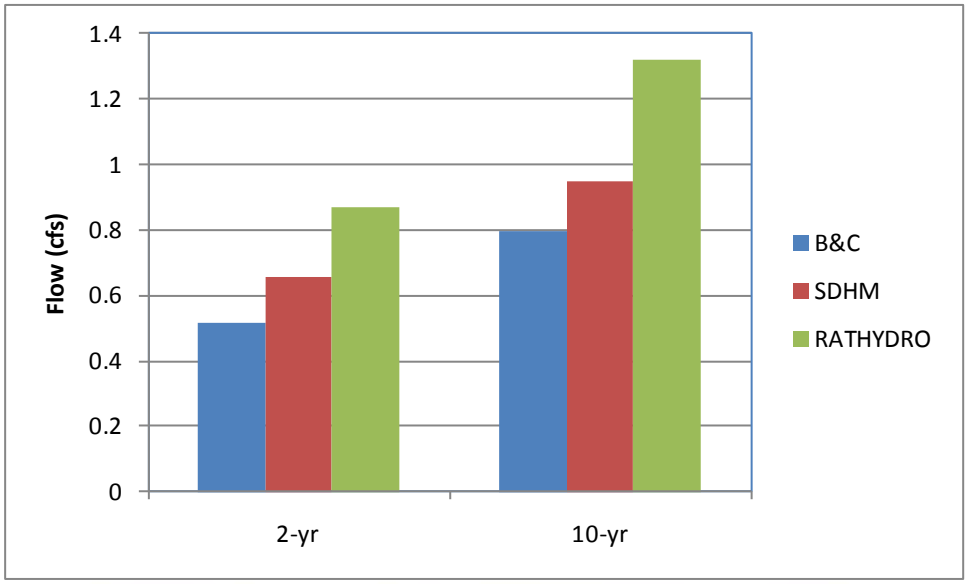


Example Discharge Area - Rational Method

FIGURE WB. 2-1

1-hr Duration Peak Flows

- WB.2 Example at Lake Wohlford – 2 and 10-year recurrence 1-hr peak flows



- SDHM > B&C due to urban irrigation (impervious runoff is identical)
- Both methods underestimate Rational Method hydrograph
- Difference is mostly due to rainfall series: 1959-2004 stats < isopluvial amounts of same duration

Adequacy of Methods to Address HMP

- HSPF modeling behind both methods is largely similar and adequate to address HMP flow duration requirements
- Neither method directly evaluates absolute magnitude of instantaneous peak flow
  - Relative reductions in hourly peaks is likely adequate for this purpose

Acceptability of SDHM2011

- SDHM2011 designed for consistency with the B&C approach; differences are minor and plausible
- SDHM2011 is technically acceptable for use to meet HMP
- However, the many user options in SDHM do not enforce requirements with design guidance; careful review of SDHM-based submissions will be needed

Summary Recommendations

1. Local calibration of HSPF parameters needed
2. Resolve use of monthly lower zone ET factors
3. Evaluate urban irrigation impacts on meeting HMP
4. 1959-2004 met data appear inconsistent with isopluvial maps. Is a longer period needed?
5. Design components of BMPs that depend on peak discharge need to continue to be evaluated with methods in the Hydrology Manual