National Trends for Stormwater Management – *National Research Council report*

The Feasibility of Stormwater Retention

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Overview of Presentation

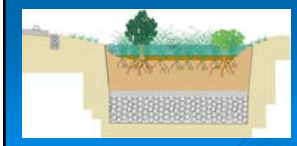
- What is Stormwater Retention?
- NRC Report Recommendations
- Definitions of LID in Recent Permits
- Options and considerations in retaining stormwater on-site
- Quantitative examples

Questions to Keep in Mind

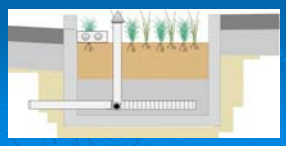
- Is reclaimed water used for irrigation or toilet flushing where you live/work?
- Is low irrigation-use landscaping encouraged or required where you live?
- Are there limitations on infiltration into soils where you live?
- Is capturing and using stormwater runoff "Re-use" or "Use"?

What does "retention on site" mean?

Retention on site



Not retention on site



NRCs - NATIONAL RESEARCH COUNCIL Urban Stormwater Management in the United States

- Current approach is not meeting all stormwater management goals
- Appropriately emphasizes the role of managing hydrology for reducing pollutant loads
- Some (NRDC) have asserted that the NRC report is a call to retain stormwater on site
- NRC report definition of LID uses term: *ARCD-Aquatic Resources Conservation Design for LID*
- ARCD (= LID) includes swales, filter strips, and bioretention cells

NRC Panel Report:

- "In some situations ARCD practices **will not be feasible**, at least not entirely, and the SCMs [stormwater control measures] conventionally used now and in the recent past (e.g., retention/detention basins, biofiltration without soil enhancement, and sand filters) should be integrated into the **overall system to realize the highest management potential**."

West Coast Permits

- Permits approved:
  - Ventura County - LA Board – Retain on site
  - North Orange County - SA Board –Retain on site with off-ramps
  - Washington State Phase 1 Permit (Puget Sound area)
- Permits in play:
  - South Orange County – SD Board
  - San Francisco Bay area – SF Board

Energy Independence and Security Act (EISA) Section 438

- Federal projects exceeding 5,000 sf must:

  *… maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the **temperature, rate, volume, and duration of flow**."*

- Suggested compliance is to evapotranspirate, infiltrate or reuse the 95th percentile, 24-hr hr storm to the METF

95% Storm Event

City	95th Percentile Event Rainfall Total (in)	City	95th PercentileEvent Rainfall Total (in)
Atlanta, GA	1.8	Kansas City, MO	1.7
Baltimore, MD	1.6	Knoxville, TN	1.5
Boston, MA	1.5	Louisville, KY	1.5
Buffalo, NY	1.1	Minneapolis, MN	1.4
Burlington, VT	1.1	New York, NY	1.7
Charleston, WV	1.2	Salt Lake City, UT	0.8
Coeur D'Alene, ID	0.7	Phoenix, AZ	1.0
Cincinnati, OH	1.5	Portland, OR	1.0
Columbus, OH	1.3	Seattle, WA	1.6
Concord, NH	1.3	Washington, DC	1.7
Denver, CO	1.1		
Geosyntec Calculations			
Bend, OR		**0.8**	

Effectiveness of Stormwater Treatment BMPs

- Function of:
  - Runoff Patterns
  - Pollutant types and forms
  - Storage Volume/Treatment Rate
  - Hydraulics/Hydrology of recovering storage
    - Deeper infiltration
    - Evapotranspiration
    - Harvest and use (irrigation/toilet flushing)
    - Draw-down/discharge rate
  - Treatment Process for released flows
    - Physical/Biochemical (settling, adsorption, filtering, etc.)
  - Operations and Maintenance

Factors Affecting Stormwater Management on The West Coast

- Weather:
  - Precipitation events arrive in clusters (frontal, not convective)
  - Most rainfall/runoff occurs in Winter Season
- Results:
  - Makes harvest and use using irrigation difficult at best
  - Evaporation loss opportunities are limited as well
  - Infiltration is the X factor

Retain on site – Options

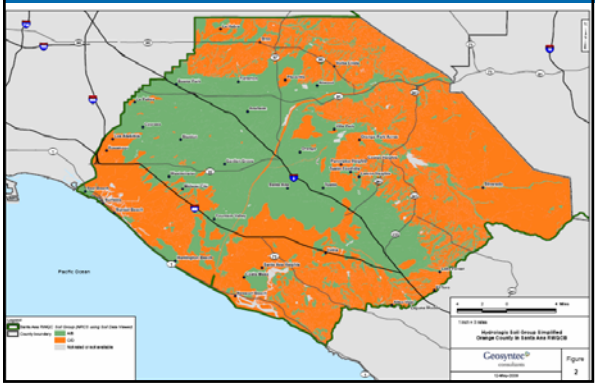
- Infiltrate
- Evapotranspirate
- Harvest and Use

Infiltration

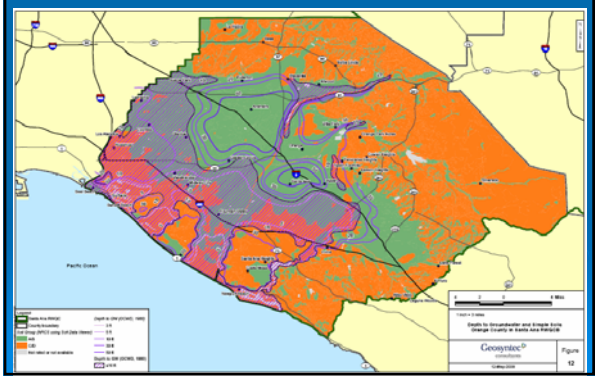
- Can you do it?
- Should you do it?
- If you do, do it carefully.

Infiltration Screening Example:
North Orange County

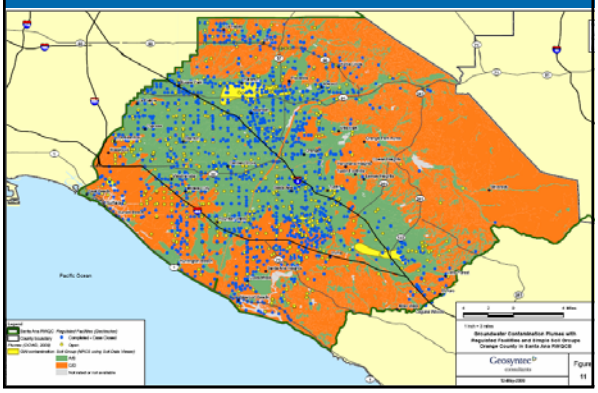
Green areas are A+B Soils



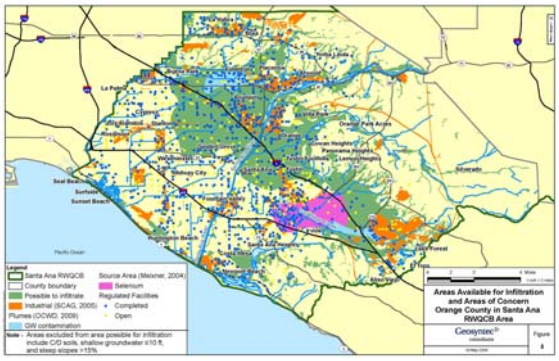
Green areas = A+B Soils
Hatched = 10 feet or less Depth to GW



Green = A+B Soils;
Dots = Contaminated Sites/Plumes



Contaminated Soils/Plumes, Depth to GW + A/B + Natural Plumes + Contaminated Sites + Industrial Land Use



Infiltration Areas

	Area (ac.)	% of permit area
Permit Area	343,431	
A/B soils	143,079	41.7
Slope < 15%	229,361	66.8
Depth to groundwater 10 feet or more	260,827	75.9
Area for infiltration excluding C/D soils, slopes > 15%, depth to groundwater ≤10 ft, industrial areas, contaminated areas (plumes and Se source area)	77,625	22.6%

For North Orange County, CA, infiltration appears to be feasible in about 23% of the permit area

Evapotranspiration

- Maximize ET
- Manage the "sponge"
- Pre=Post ET almost impossible

Spatial Water Balance Considerations

Imperviousness = 0%

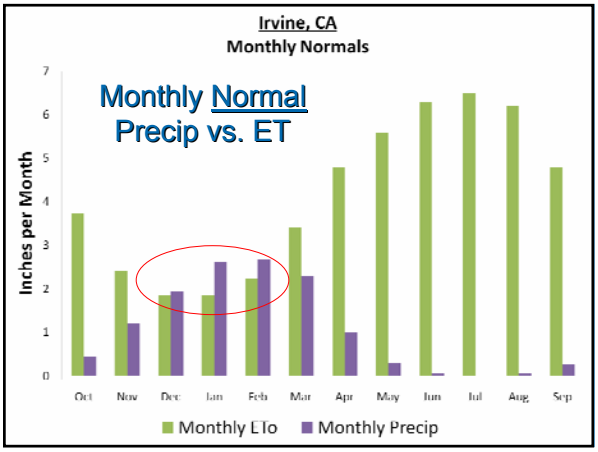
1" Rainfall = 1" Over Pervious Surface
Shallow localized ponding
Unsaturated infiltration dominates
"Sponge" area ≈ watershed area

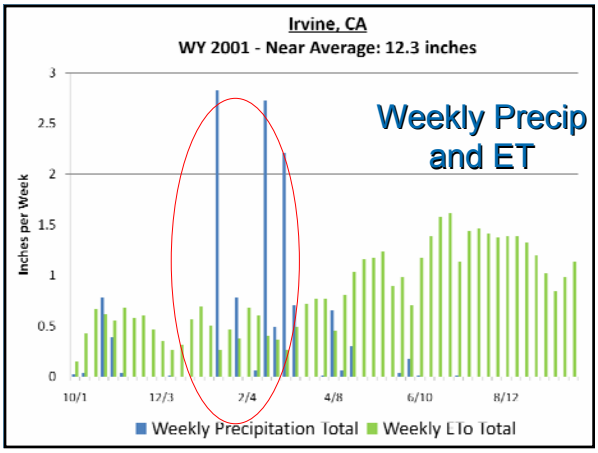
Imperviousness = 50%; BMP = 5%

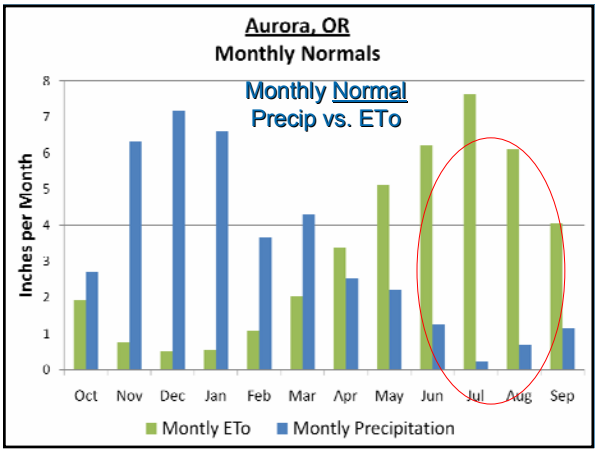
1" Rainfall ≈ 10" Over BMP
Concentrated ponding in BMP
Unsaturated and saturated infiltration
"Sponge" area = BMP area

Temporal Water Balance Considerations

Southern California and Oregon Examples







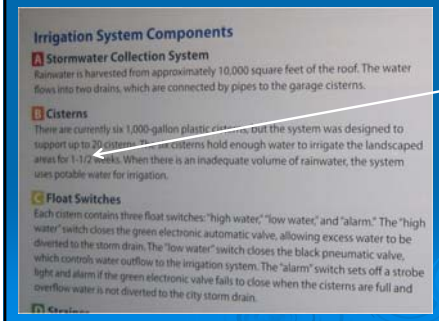
Capture and Use (re-use)

- Key factors for success of capture and use:
  - Having a use for the water
  - Being able to use the water
  - Being able to use the water fast enough

EPA Headquarters- Harvest and Use Cistern (Washington, D.C.

- Eric visited on April 28th, 2009 (about 80 degrees that day)
- Cisterns were still off-line due to lack of irrigation demand

EPA Headquarters- Harvest and Use Cistern


Irrigation System Components

A Stormwater Collection System

Rainwater is harvested from approximately 10,000 square feet of the roof. The water flows into two drains, which are connected by pipes to the garage cisterns.

B Cisterns

There are currently six 1,000-gallon plastic cisterns, but the system was designed to support up to 20 cisterns. The six cisterns hold enough water to irrigate the landscaped areas for 1-1/2 weeks. When there is an inadequate volume of rainwater, the system uses potable water for irrigation.

C Float Switches

Each cistern contains three float switches: "high water," "low water," and "alarm." The "high water" switch closes the green electronic automatic valve, allowing excess water to be diverted to the storm drain. The "low water" switch closes the black pneumatic valve, which controls water outflow to the irrigation system. The "alarm" switch sets off a strobe light and alarm if the green electronic valve fails to close when the cisterns are full and overflow water is not diverted to the city storm drain.

- 6 Tanks store about 1" of rainfall from roof
- About 10 days to drain the tanks when full
- Likely that significant amount of runoff bypasses the tank when tanks on-line

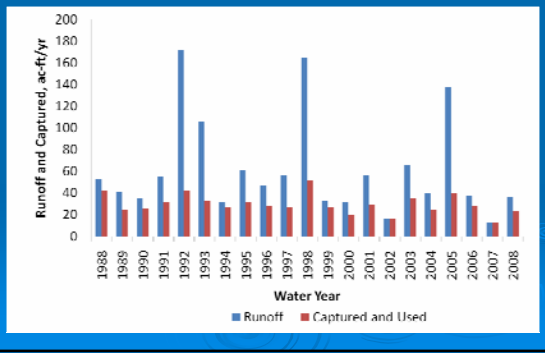
Quantitative Examples

Harvesting and Use

Residential Scenario: Irvine, CA

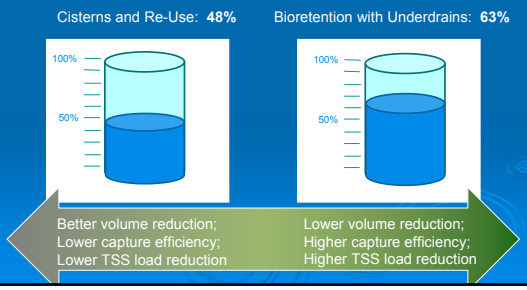
- 100 ac Residential Catchment @ 60% impervious
- Tank sized to 0.8" storm = 1.3 MG (Irvine, CA WQ Design Storm)
- Indoor non-potable demand (Toilet Flushing) = 65 gpd/du, assumed 4.5 du/ac
- Outdoor ET demand = monthly average ETo x assumed 30 ac of irrigated area (irrigation always on regardless of rainfall)
- Rainfall and ETo data from Irvine CIMIS station (WY 1988-2008), ETo simulated as monthly averages (not normals)
- **Overall capture efficiency = 48%**

Individual Water Year Performance



Pollutant Loading Example

- Example 100-acre residential, 0.8” cistern
- Results – Bioretention with underdrains showed higher TSS loading reductions



Residential Scenario: Aurora, OR

- Same scenario as Irvine (100 ac, 1.3 MG tank, irrigation and toilet flushing)
- Precip and ET from Aurora, Oregon Gage (1998-2009)
- Overall capture efficiency = 33%
- Capture efficiency for individual water years ranges from about 20% to 60%

Commercial Office Building Example

- Oregon Clinic: medical office bldg, Portland, Oregon
- 33,000 sf roof area
- 20,000 gallon cistern
- Water used in toilets and urinals: 650-1,200 gpd
- Supplemented by non-potable and potable water

Oregon Clinic: System Components

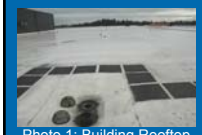


Photo 1: Building Rooftop and Drains

Photo 3: Filter Cartridge and UV Light

Photo 4: Non-Potable Water Mixing Tank

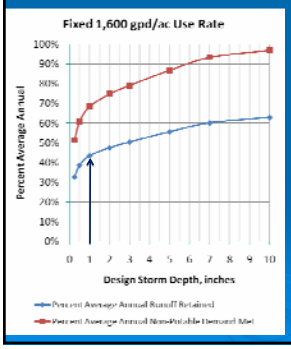
Photo 2: Bag Filter Housing

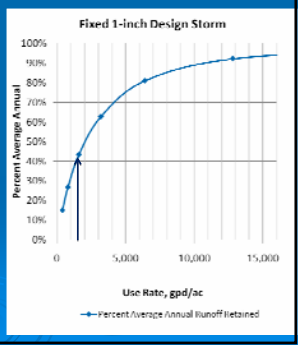
Photo 5: Booster Pump and Expansion Tank

Oregon Clinic: Anticipated Long-term Performance

- Approx. 45 percent reduction in average annual runoff
- Approx. 60 percent reduction in non-potable water demand
- Overall, 23% reduction in water leaving site. Good enough?

Oregon Clinic: Improving Performance?





Stormwater Capture/Harvest and Use

- Must drain tank relatively fast
- Irrigation use limited:
  - Seasonal issues
  - "Zeroscaping" push
  - Competition with reclaimed water
- Toilet flushing possible with high enough densities (TUTIA – Toilet Users To Impervious Area Ratio)
- Combine with grey water systems?
- Explore integrated water management opportunities
- Think about big-picture meaning of sustainability

Summary/Recommendations

- Infiltration is not broadly feasible, effective and/or desirable (maximize where appropriate)
- Harvest and use of runoff due to runoff patterns and ET potential has limited applications where it can be effective (should be maximized) - opportunities should be explored for other uses of wate
- There needs to be more technical vetting of retain on site and stormwater harvest/use before these approaches are made mandatory
- Approaches should consider watershed- and site-specific factors

Thank You

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