Re-inventing the Nation’s Urban Water Infrastructure [ReNUWIt]

Got Water??
Urban Stormwater: Capture-treatment-use

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and the ReNUWIt Team

Frank Gehrke (chief of snow surveys) and Gov. Jerry Brown

“Measuring” the Sierra snowpack on April 1, 2015

First time that there was no snow to measure
El Niño December – February

Strongest indications in past 50 years – still not drought-busting

What does it mean in terms of lost water?

Take-home message: Stormwater

- Source of pollution from urban watersheds
- Use of urban stormwater can:
  - Curtail discharges
  - Contribute to water supplies
- Stormwater capture can diversify water supply portfolio
- How to capture urban stormwater and remove contaminants are research questions
  - Research in Los Angeles and Sonoma County—both experimental & modeling
Engineering urban systems to improve water quantity, water quality, & habitat

Urban stormwater activities

National Research Council
Study committee on “beneficial use of graywater & stormwater”

ReNUWIIt
Stormwater capture, treatment & recharge systems
Lab and field work:
Sonoma County Water Agency
LA Dept. of Water & Power
**Stormwater and urban water**

**Midwest & East Coast**
- **Combined sewers** (sewage and stormwater in same pipe)
- Sewer overflows

**West coast and southwest**
- **Separate sewers** (stormwater sewers and sanitary sewers)
- Stormwater for flood control
- Beach pollution (CA & elsewhere)
- Stormwater for urban water supply

Combined sewer overflows are mainly a problem for cities in the northeast and Midwest.
Dissolved oxygen concentration in the Chesapeake Bay. Levels less than 2 mg/L are considered hypoxic, but impacts to biota are observed at < 4 mg/L.

Stormwater accounts for 8% of nitrogen and 15% of phosphorus loads.

Drivers for stormwater reuse

Scarcity
Water supply reliability and diversification
Pollution prevention
Hydromodification management (less erosion)
Energy savings and Green House Gas reductions
Environmental stewardship (doing the right thing)
Extending the capacity of existing infrastructure
Financial incentives (building permits)
Stormwater volumes (acre – ft)

(325,851 gallons; about 1/3 million gallons)

Stormwater for urban water supply

Governor signs stormwater capture bill

Governor Jerry Brown signed legislation by Senator Fran Pavley (D-Agoura Hills) on Thursday to encourage the capture and use of stormwater, part of a package of bills designed to create more reliable water supplies and make California’s water system more sustainable.

Stormwater has the potential to supply up to 630,000 acre feet of water in Southern California and the Bay Area alone.
Stormwater in California

Flashy events, localized flooding, lost resource, polluted beaches

“Slaking a Region’s Thirst While Cleaning Its Beaches”

Sun Valley Neighborhood

Los Angeles River

New York Times, April 8, 2013

Stormwater capture potential in greater Los Angles Region

Stormwater capture projects can increase deep percolation and decrease runoff by factor of 3.

Data source: Los Angeles & San Gabriel Rivers Watershed Council, 2010
The City of Los Angeles: stormwater reuse at different scales

- Stormwater capture projections
- Incidental recharge (area-wide percolation)
- Decentralized systems
  - Individual household – Rain barrels and cisterns
  - Neighborhood – Elmer Avenue example
- Centralized systems
  - Sub-regional – Rory M. Shaw Wetlands Park
  - Regional – Pacoima Spreading Grounds

Rain barrels don’t provide enough water in areas with seasonal rainfall patterns
Los Angeles: today and tomorrow

2006-10 Average
Total - 621,700 AFY

- LA Aqueduct: 36%
- Local GW: 11%
- Recycled Water: 1%
- MWD: 52%

Projected 2034-35
Total - 710,800 AFY

- LA Aqueduct: 33%
- Local GW: 16%
- Recycled Water: 8%
- Stormwater Capture: 4%
- Conservation: 2%
- Transfers: 6%
- MWD: 24%

Stormwater capture & recharge

LA’s stormwater capture master plan --- an aggressive path *this century* could add nearly 200,000 afy from today’s baseline (Villegas, SCMP, 2014)
Different scenario assumptions

- Centralized facility enhancements
- Land use limitations
- Groundwater contamination cleanup
- Implementation rates of decentralized programs
- Water table level constraints (no overdraft)
- Available financing

Neighborhood scale – Elmer Avenue

- 24 homes, 40 acre drainage
- Collaboration among NGOs, utilities, and residents
- Residents maintain both private property and right-of-way features.
- Costs: $2.5 million (capital), $12,000/year (O&M)
- Infiltration of 16 AFY
Photo A Elmer Avenue Infiltration Galleries Under Construction

16 acre-ft per year
24 participating homes
$2.5 million construction costs

Photo B Elmer Avenue Curbside Bio-Swale Filled by Half-Inch Rainstorm

Elmer Ave.
District scale, Sun Valley, Los Angles

Sun Valley District, Los Angles

Strathern Pit and future
Rory M. Shaw Wetlands
Sub-regional scale – Rory M. Shaw
Wetlands Park

- Convert 45-acre gravel pit into facility for stormwater retention, treatment, groundwater recharge, habitat & recreation.
- Costs: $46 mill ($28 mill for land), $240,000/year (O&M)
- Volume recharge: 900 AFY

Strathern Pit, Sun Valley District
Los Angeles

Today:
50 acre pit

Salvage yards & industrial drainage

Future:
Stormwater collection, treatment & recharge.

50 acre treatment wetland and park
Contract just signed with: LA Dept. of Water and Power, Department of Public Works, and Bureau of Sanitation

Rory M. Shaw Wetlands, Los Angeles
Urban stormwater chemicals

Urban-use biocides
- diuron, triazines,
- chlorophenoxyacetic acids,
- pyrethroids, fipronil

Vehicle-related compounds
- PAHs, benzothiazoles & alkylphenols (rubber additives), benzotriazoles (anti-freeze)

Test bed work in Los Angeles

Rory M. Shaw Wetland Park
(in design/construction)

How may geomedia improve quality of stormwater for recharge from heavily urbanized area in LA?

Biochar
Fe-Oxides
Mn-Oxides
Act. Carbon
Sand, Gravel (high Kₘₙₜ base)
Regional scale: Pacoima Spreading Grounds

- Twelve basins, first used in 1932
- Area: 169 acres
- Current capacities:
  - Intake: 600 CFS
  - Storage: 440 AF
  - Percolation: 65 CFS
- Annual recharge: 6,500 AFY
- Rehab underway to more than double recharge ($28 million)

Project economies of scale

Source: Southern California Water Committee, 2013
Coupled recycled water & stormwater recharge

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Sonoma County: developing stormwater management priorities

- **Two main objectives**: flood hazard reduction & groundwater recharge

- **Systems-level view**: integrated land use planning and public acceptance.

- **Multi-benefit projects**: community benefits, maintain open space, ecosystem functions

Test bed work at Sonoma 2015-16
Test bed work at Sonoma

Layering order is Ongoing Research (N2.4)