



Stormwater Impacts on Groundwater Quality: A Review of Available Information

Presented by:

Aspect Consulting, LLC

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West Seattle - Dec. 3, 2007



Photos from:
www.WestSeattleBlog.com

RAINFALL ACROSS THE CITY

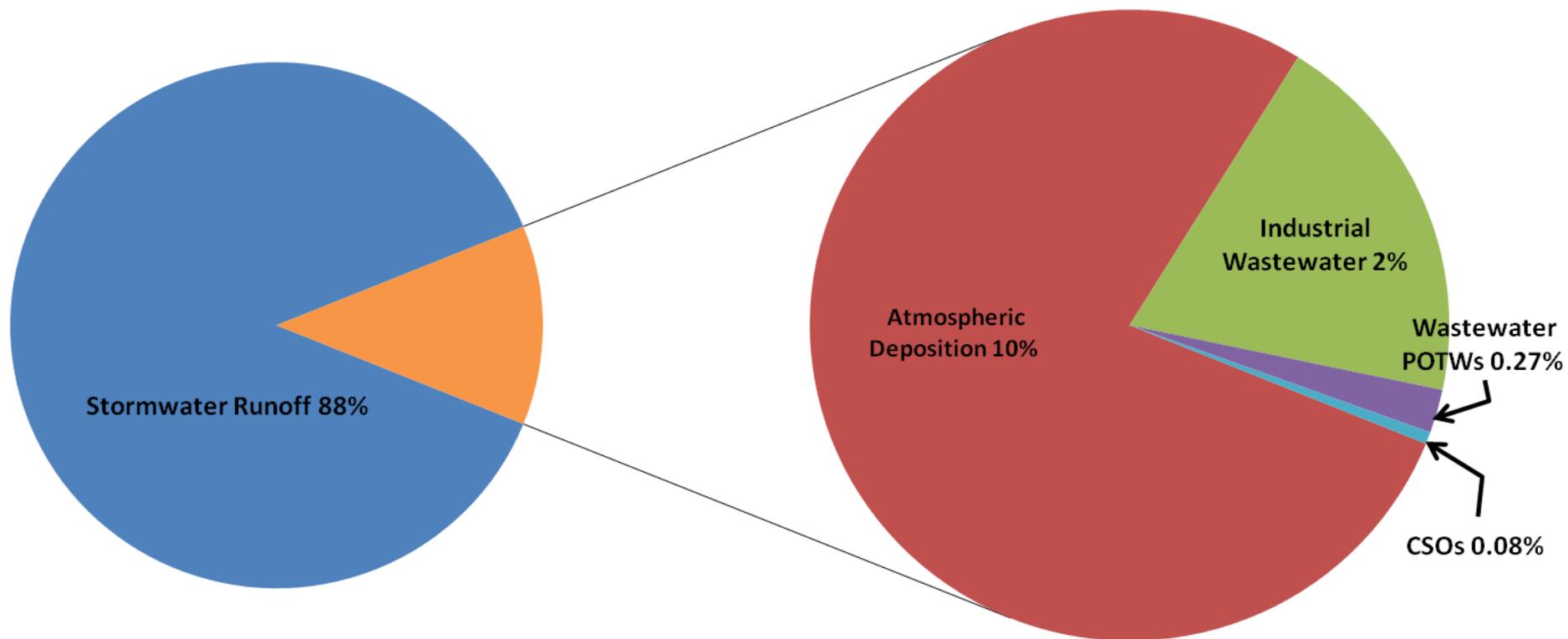
Precipitation measured by rain gauges throughout the city during the Dec. 3 storm.



Source: Seattle Public Utilities

SEATTLE P-I

Sources of Non-Petroleum Toxics Loading to Puget Sound

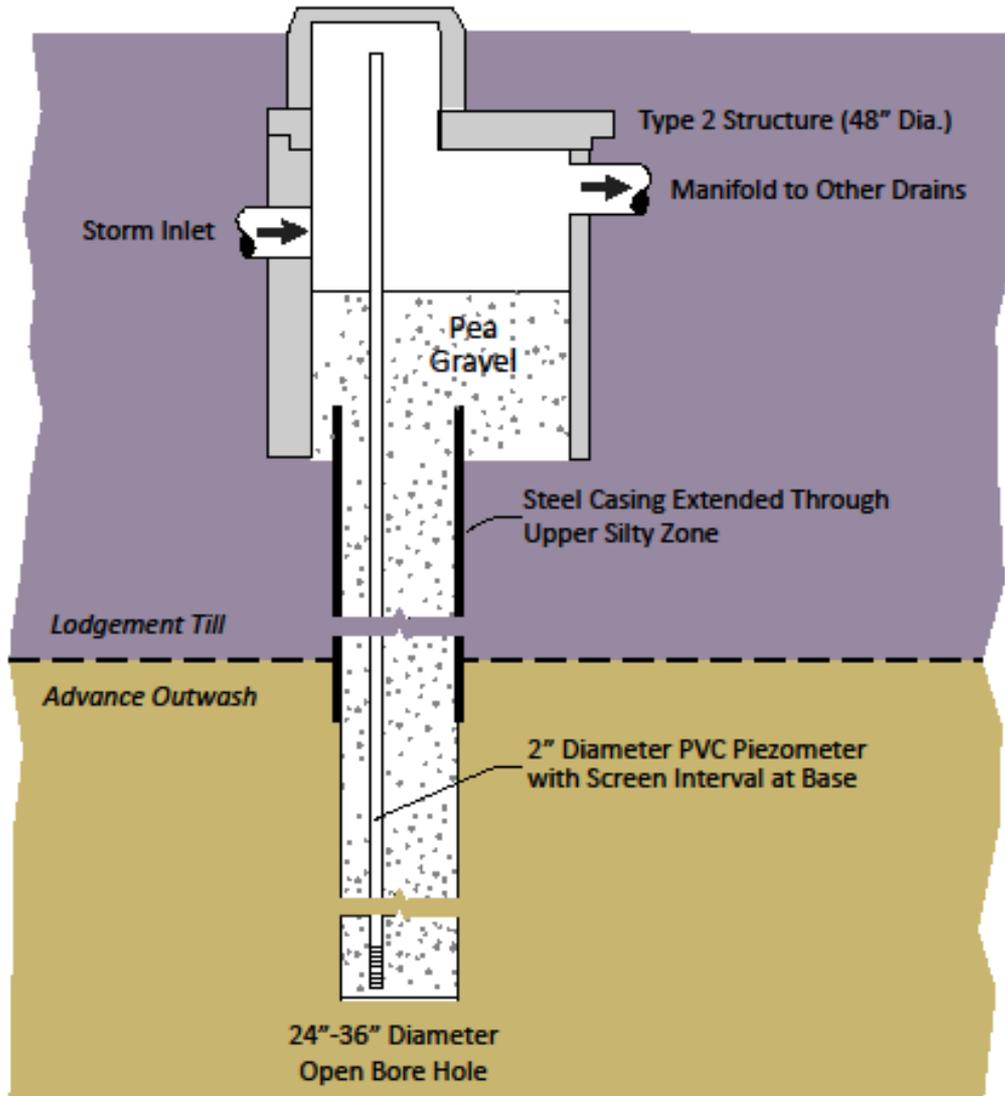


Phase 1: Initial Estimate of Toxic Chemical Loadings to Puget Sound, Hart Crowser, et. al., 2007, and Phase 2: Improved Estimates of Toxic Chemical Loadings to Puget Sound from Surface Runoff and Roadways, EnviroVision et al., 2008

The Role of Infiltration in Solving these Problems

- Benefits
 - Reduce peak flows (CSO's, erosion, etc.)
 - Reduce toxic loading to surface water
 - Increase groundwater levels and summer stream flows
- We need to be smart about our LID designs and make sure they are designed to achieve our objectives at the lowest cost





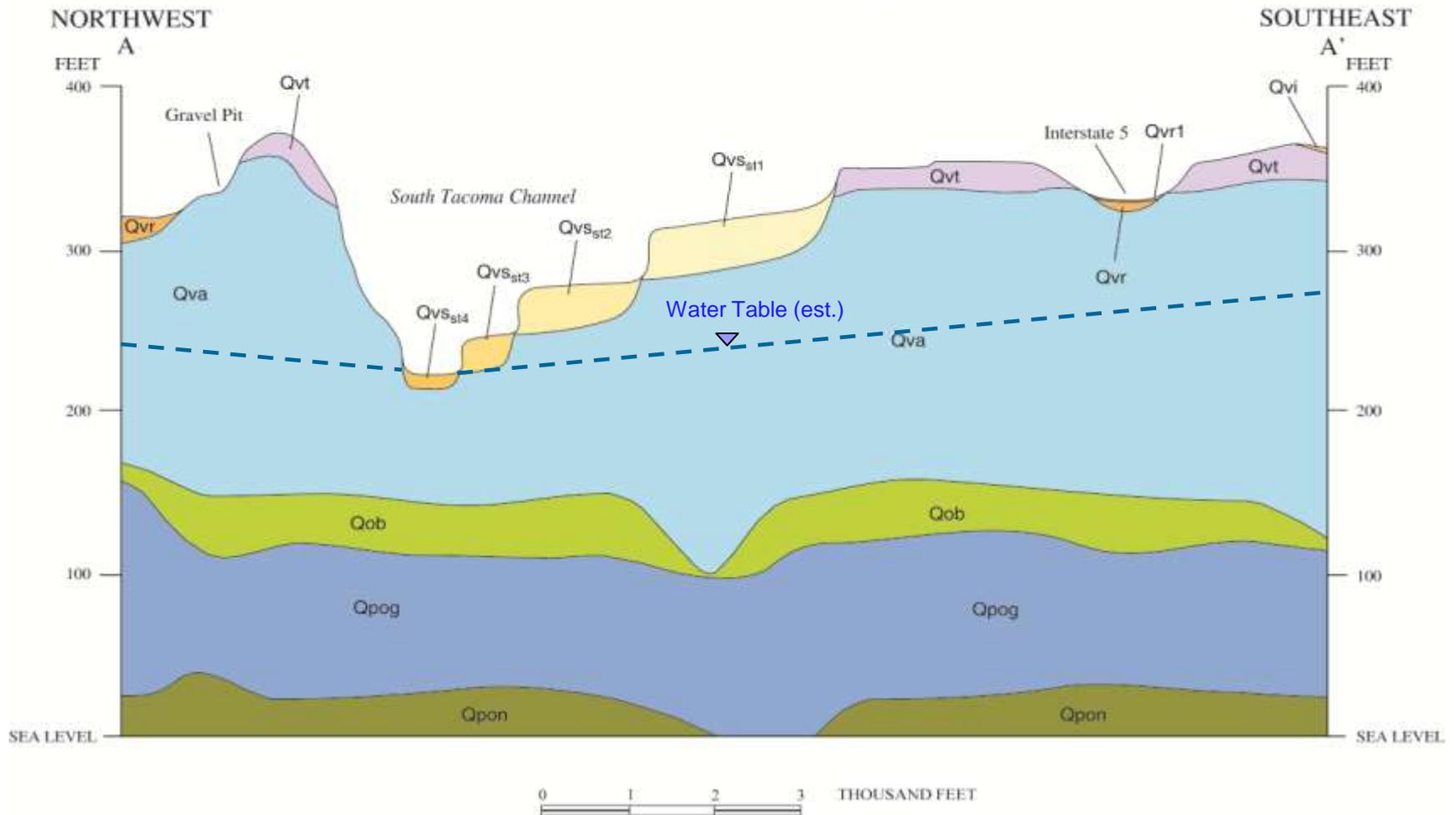
Stand-Alone Drilled Drain Completion Detail

- Typically 2-3 ft in diameter
- Backfilled with Pea Gravel
- Type 2 Structure
- Piezometer
- May include surface casing

Infiltration often Feasible Beneath Till

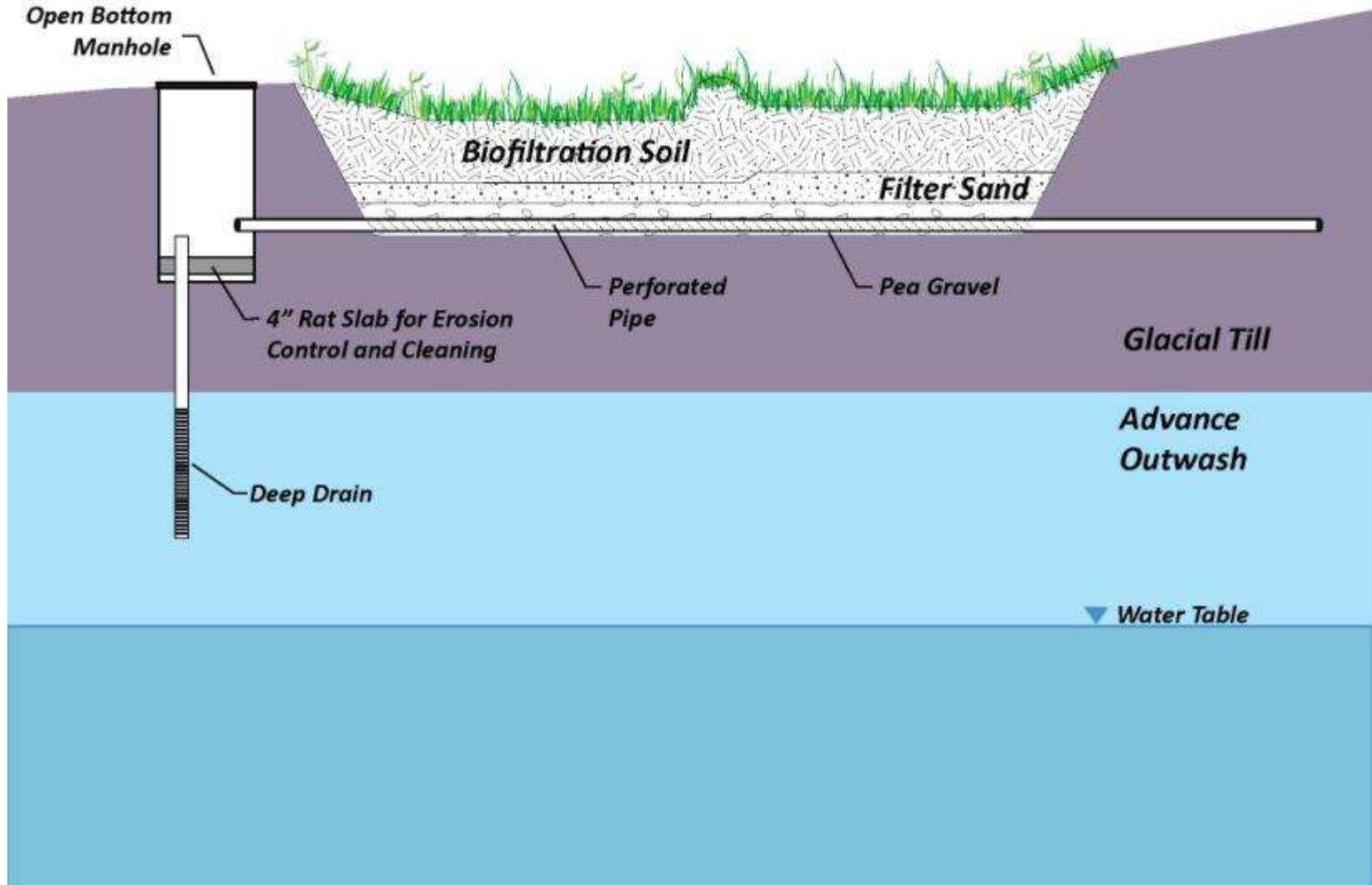
SCHMATIC CROSS SECTION OF THE SOUTH TACOMA CHANNEL

[View looking northeast; vertical exaggeration X20]



Rain Garden Connected to Deep Drain

Raingarden Connected to Deep Infiltration Drain



SW Infiltration: Potential Impacts on Groundwater Quality

- Widespread historic use of stormwater infiltration:
 - ~9,000 drywells in Portland
 - ~10,000 dry wells in Spokane county
 - ~5,000 dry wells in Yakima county
 - ~40,000 dry wells in Arizona
 - 100's? of infiltration facilities in western Washington
- Many qualitative/theoretical discussions, sparse real world data
- Known examples of contaminated wells from stormwater infiltration difficult (impossible?) to find



EPA, 1983. Results of the Nationwide Urban Runoff Program

- Looked at GW impacts associated with infiltration basins in Long Island, NY and Fresno, CA
- Studies limited to sites with GW deeper than 20 feet
- Heavy metals, most organics, most pesticides, and coliform bacteria are sorbed to soil and do not reach GW
- Contaminants retained within several meters of surface



A Quest for Credible Real World Data

- Phoenix, AZ 1985 study
- Fresno, CA 1995 study
- Los Angeles, CA 2005 study
- Portland UIC data (Barbara Adkins)
- Spokane data (Rob Lindsay)



Schmidt, K.D., 1985, Results of Dry Well Monitoring Project for a Commercial Site in the Phoenix Urban Area, Maricopa Association of Governments.

- GW sampling upgradient and downgradient of retail development with 2 dry wells completed 30 feet beneath water table
- No treatment other than settling chambers
- Monitoring wells installed within 20 feet of dry wells
- Tested for major inorganic constituents, metals, VOCs and pesticides
- No stormwater pollutants found in groundwater



Arizona DEQ Requires an Aquifer Protection Permit for Certain Facilities (Petroleum and Haz. Substances)

- Safeguards may include:
 - Raised inlet lips
 - Pretreatment sumps, interceptors, settling chambers
 - Oil-water separators; passive skimmers; inlet filters; and absorbents
 - Settling chamber sampling,
 - Operation, maintenance, and inspection requirements
 - Recordkeeping, spill response, closure and decommissioning
- Essentially a SPCC plan...



Chuck Graf, Arizona DEQ, Southwest Hydrology, Jan/Feb, 2010

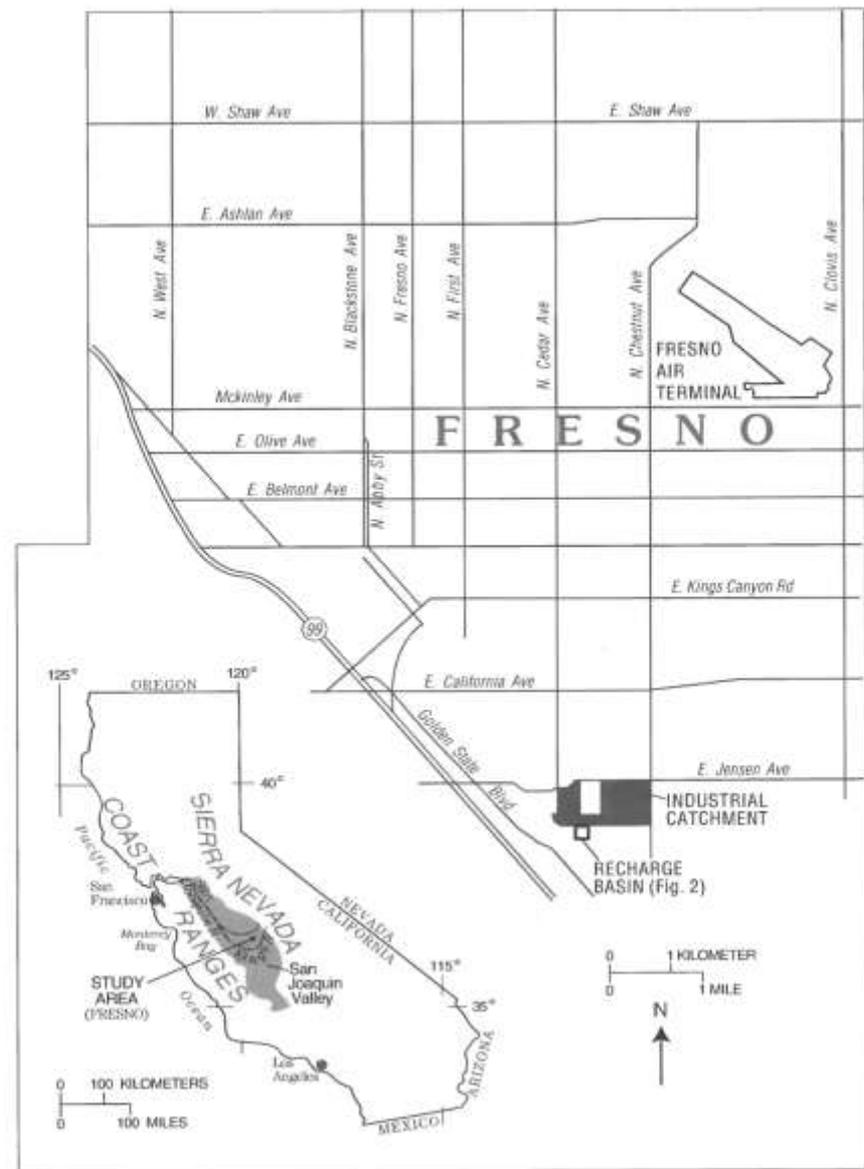
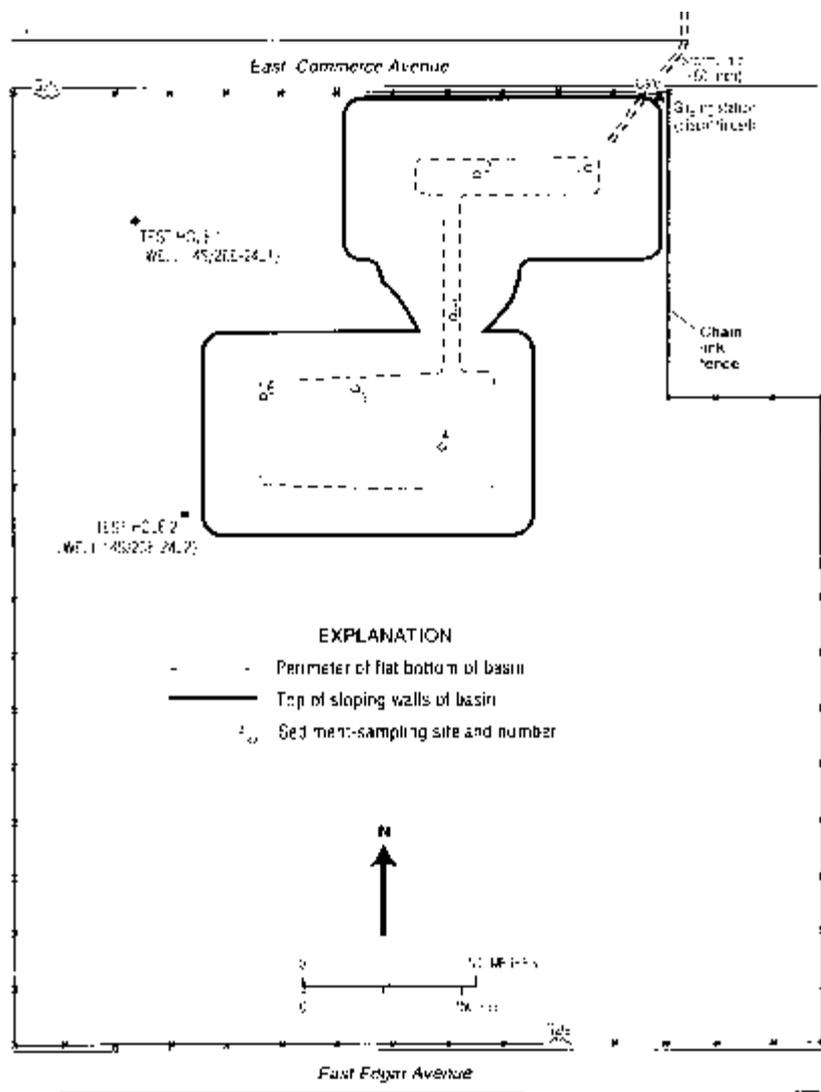
- The aggregate net recharge to alluvial aquifers from drywells is significant
- The overall impact on groundwater is believed to be low.
- State now requires 10 ft of GW separation
- Arizona DEQ Requires an Aquifer Protection Permit for Certain Facilities (Petroleum and Haz. Substances)
- Modern drywell technology, combined with adequate water-table separation and proper operational practices, may actually improve overall groundwater quality

Schroeder, R. 1995. Potential for Chemical Transport Beneath a Storm-Runoff Recharge (Retention) Basin for an Industrial Catchment in Fresno, California. U.S. Geological Survey Water Resources Investigations Report 93-4140

- Basin has a catchment of 280 acres
- 53% impervious, 66% industrial land use
- 1.25 acre infiltration basin underlain by fine to coarse sand
- Basin usually flooded due to sediment clogging (no pre-treatment)
- Last dredged 4 years before study
- 25 feet to GW



Fresno Site

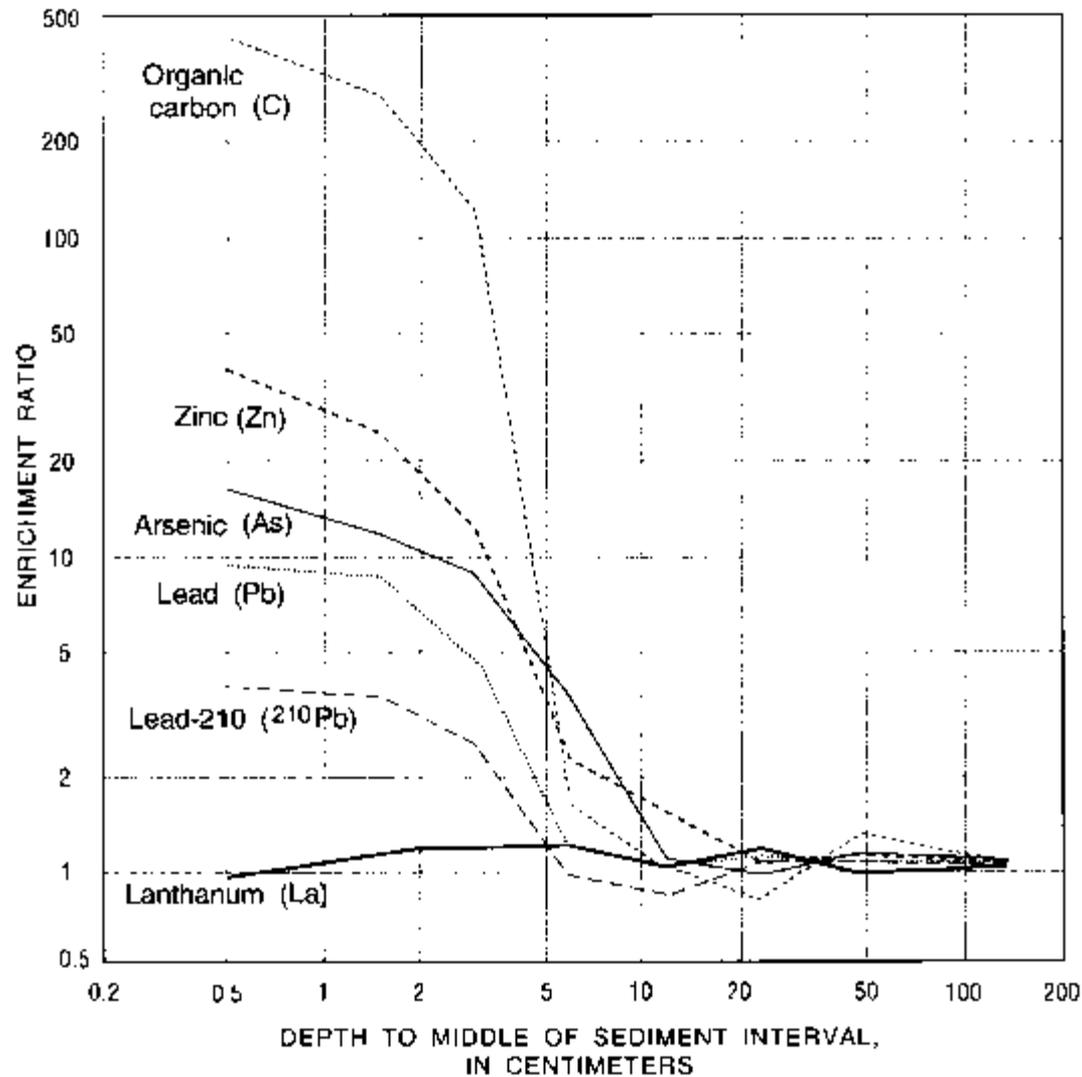


Fresno Results

- 8-16 cm of accumulated sediment in basin
- Significant sorption of contaminants (metals, pesticides, oil and grease, PAHs, etc.) in upper 5-20 cm of basin sediments
- No elevated stormwater contaminants in GW



Concentrations in Sediment with depth



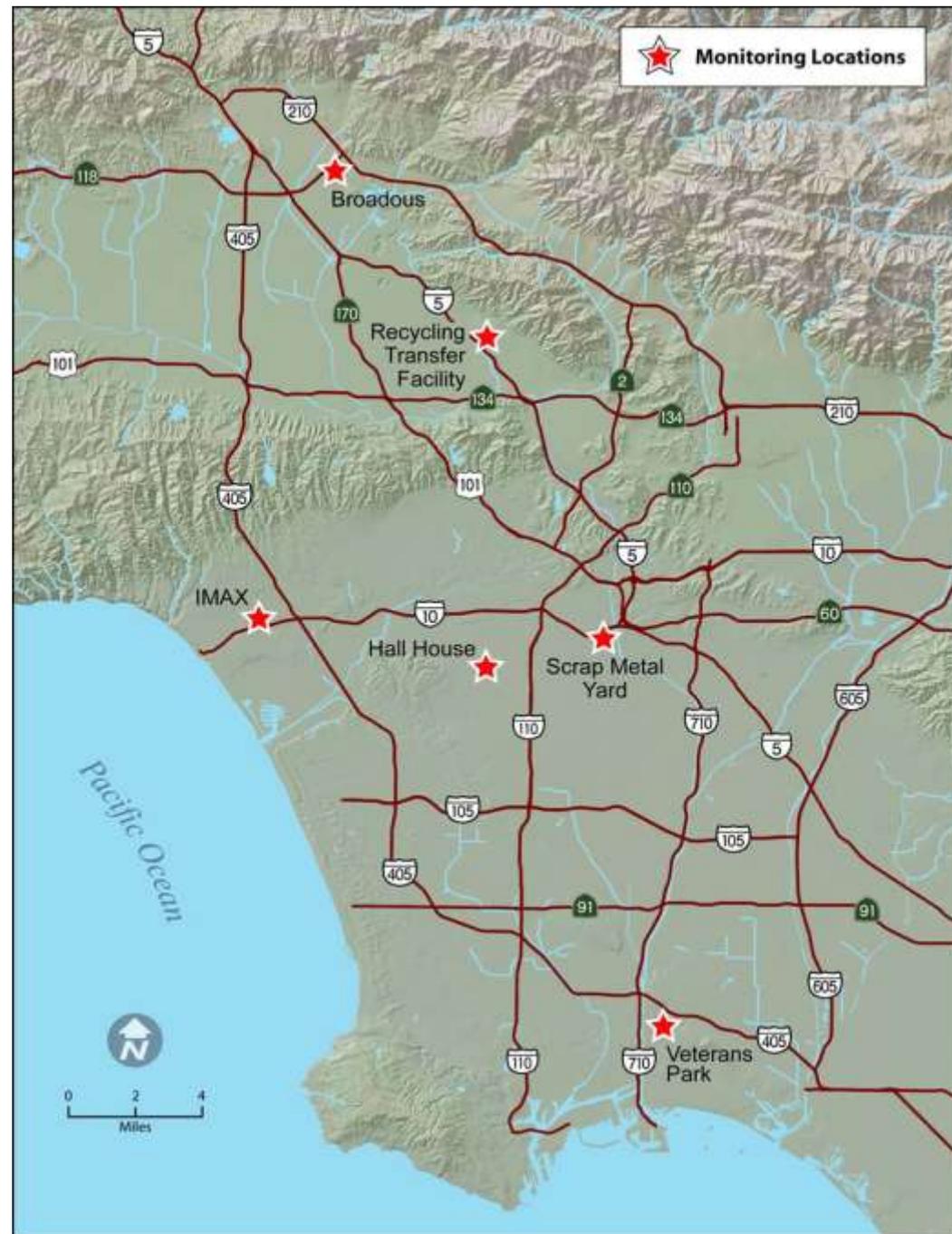
Los Angeles Basin Water Augmentation Study

- Long term research study to explore potential for promoting stormwater infiltration without impacting groundwater quality
- Involved a number of agencies:
 - LA and San Gabriel Rivers Watershed Council
 - LA Regional Water Quality Control Board
 - CA Dept. of Water Resources
 - US Bureau of Reclamation
 - Others...



Facilities Studied

- Broadous School
- Sun Valley recycling transfer facility
- IMAX office building
- Hall house residence
- Scrap metal yard
- Veterans Park



Monitoring Sites

Ref: LA Basin Water Augmentation Study, Phase II
Final Report, 2005

School



Recycling Facility



City Park



Metal Recycler



General Conditions and Approach

- Depth to GW ranged from 20 to 350 feet
- Relatively low tech treatment: settlement tanks/basins, vegetated swales, oil/water separator, etc.
- Infiltration swales, large scale infiltration fields, drywells
- Samples collected from vadose zone lysimeters and groundwater wells
- Analyzed for general WQ parameters, metals, oil and grease, perchlorate, pesticides, VOCs, SVOCs, surfactants, and bacteria
- 4 years of monitoring



LA Study Results

- Excellent removal of fecal coliform and E. coli
- No evidence of increasing metals concentrations in GW, except elevated copper in one mid-depth lysimeter at recycling facility
- At city park, GW conc. of nitrate, chloride, TDS and salts decreased due to SW infiltration
- General conclusion: no negative impacts on GW



More Information

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