

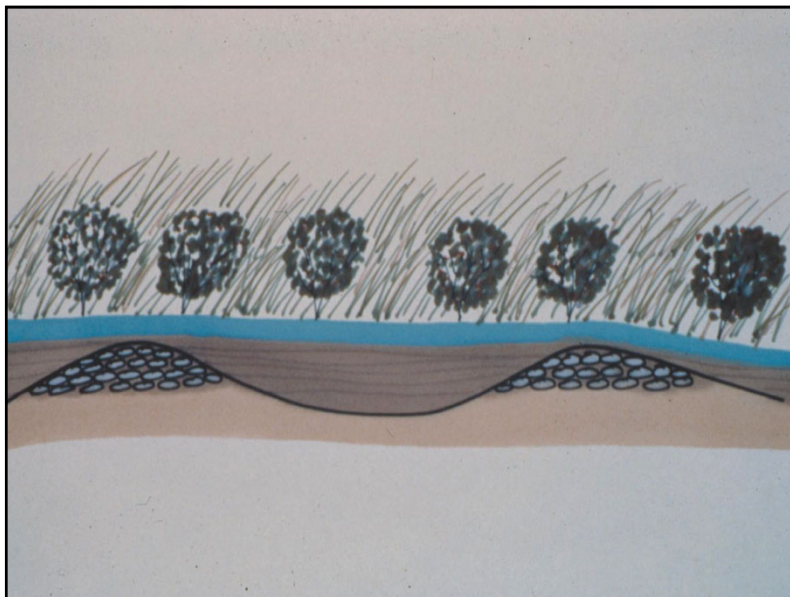
Review of Historical Street Dust and Dirt Accumulation and Washoff Data

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University of Alabama
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Wisconsin Dept. of Transportation
Madison, WI

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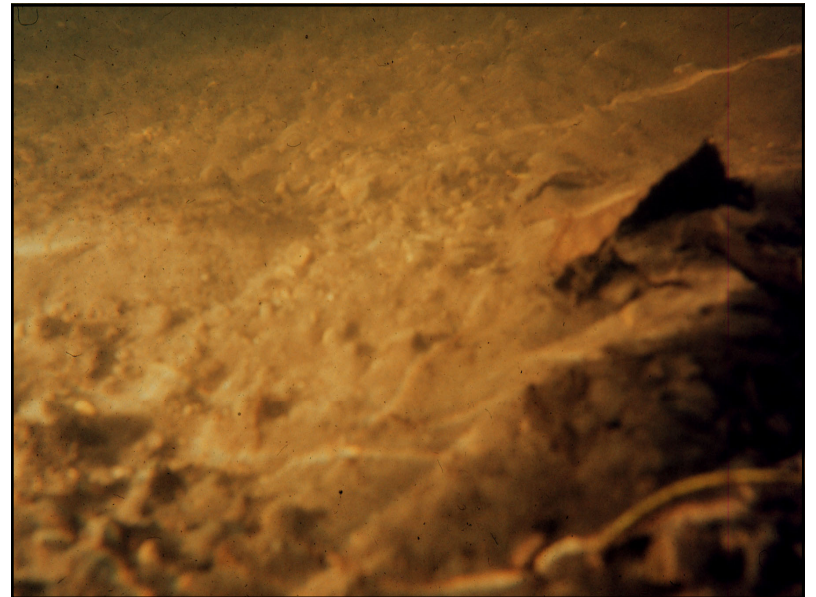
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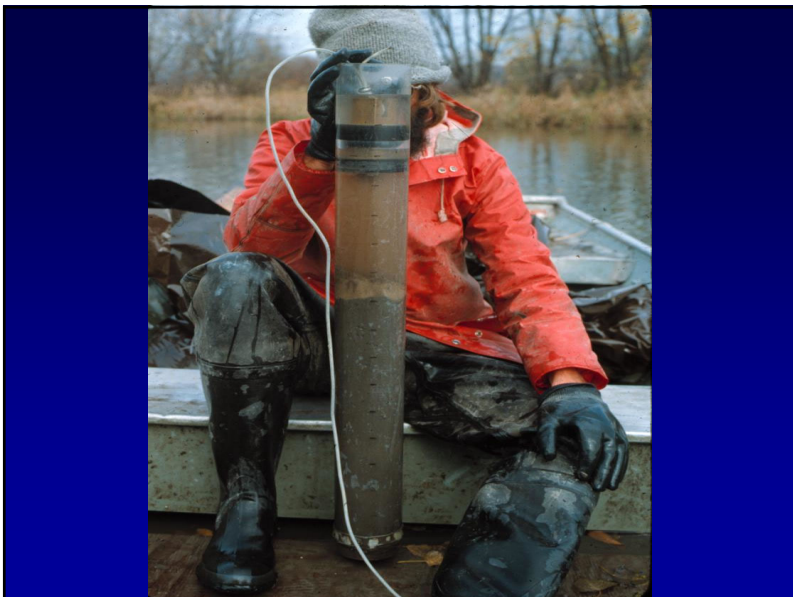
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Major Sediment Source Along Highways



Wisconsin Dept. of Natural Resources

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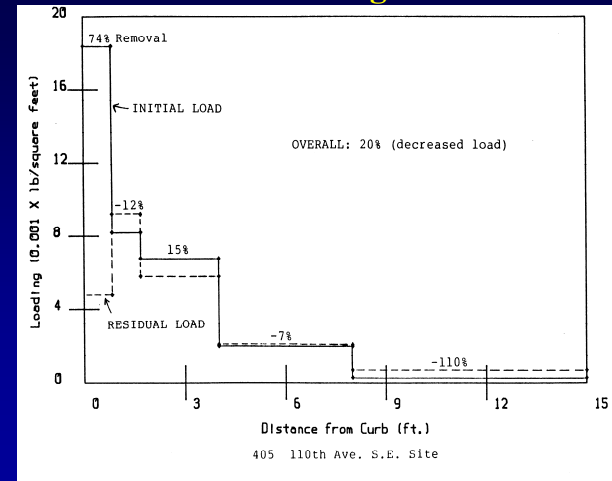


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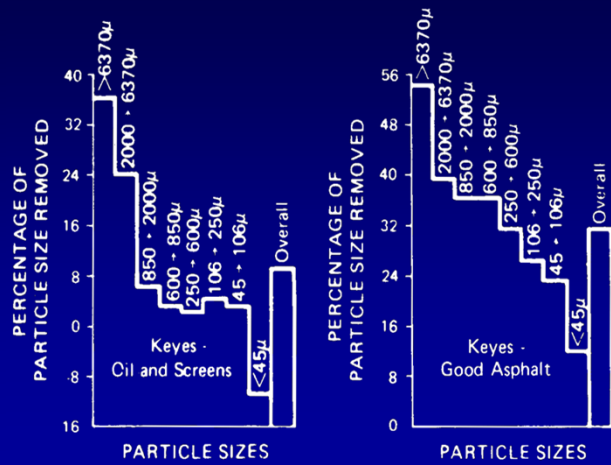
Redistribution of Street Dirt During Street Cleaning



Pitt 1985

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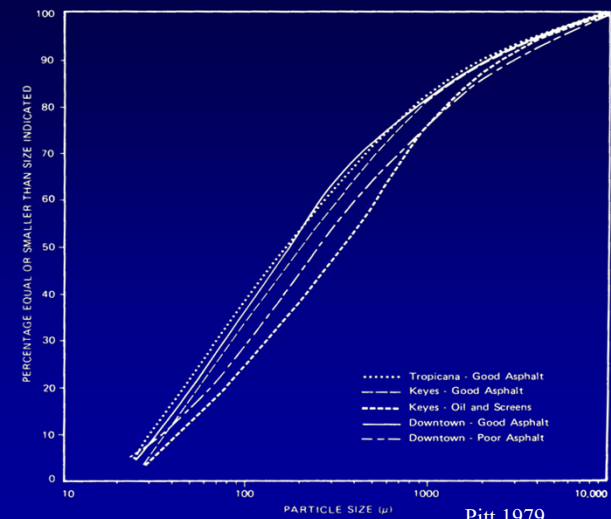
Total Solids Removal by Street Cleaning



Pitt 1979

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Particle Size Distribution of Street Dirt



Pitt 1979

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Street Dirt Chemical Quality (mg/kg)

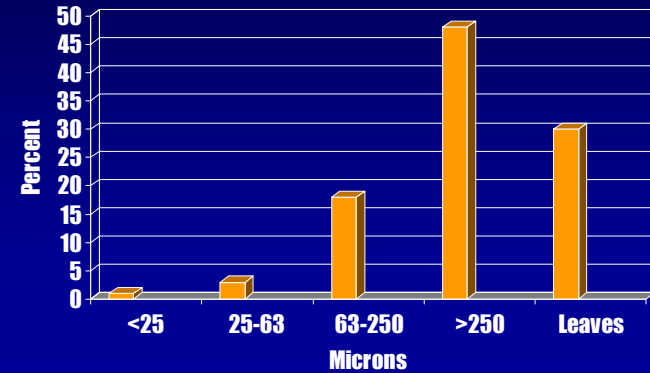
(Milwaukee, WI; San Jose, CA; Bellevue, WA; Toronto, Canada; Reno, NV; Champaign, IL)

Phosphorus (P)	400 – 1500
Total Kjeldahl Nitrogen	290 – 4300
Chemical Oxygen Demand	65,000 – 340,000
Copper (Cu)	110 – 420
Lead (Pb)	530 – 7500
Zinc (Zn)	260 – 1200
Cadmium (Cd)	<3 – 5
Chromium (Cr)	31 – 180

Pitt, Bannerman, and others

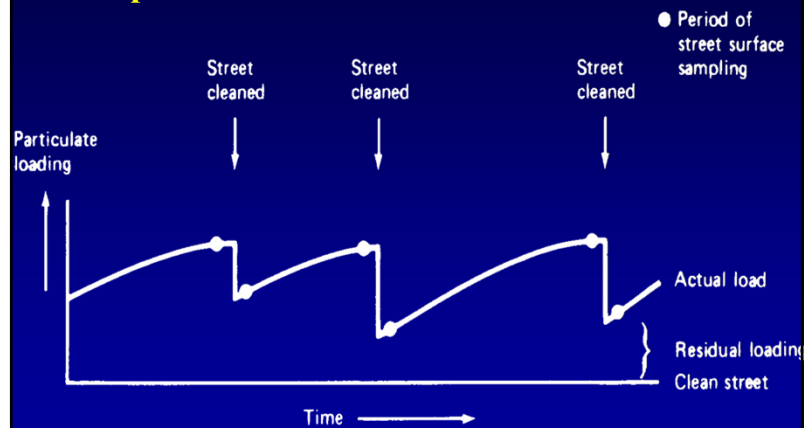
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Size Distribution of Total P in Street Dirt



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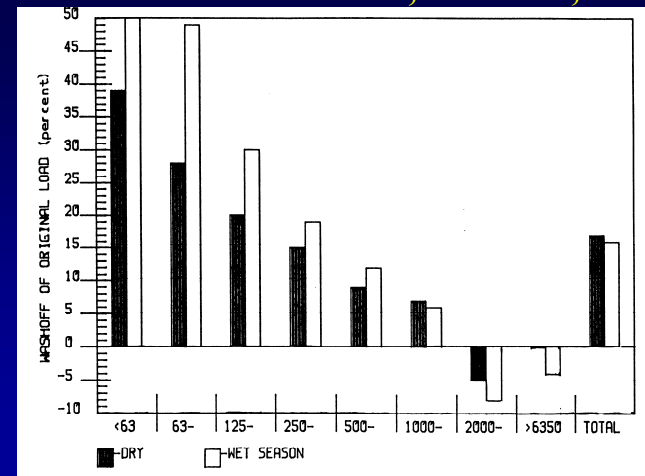
Sawtooth Pattern Associated with Deposition and Removal of Particulates



Pitt 1979

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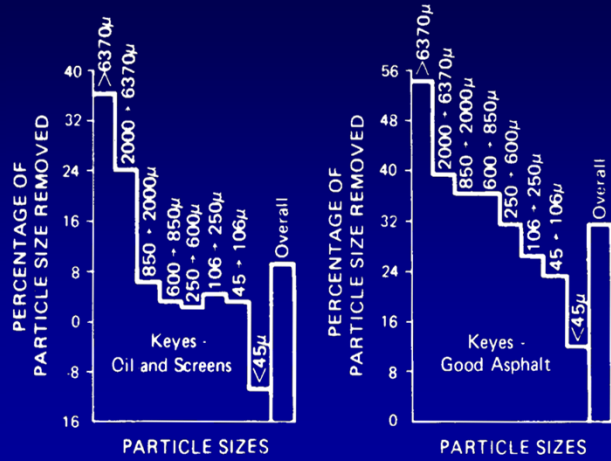
Washoff of Street Dirt, Bellevue, WA



Pitt 1985

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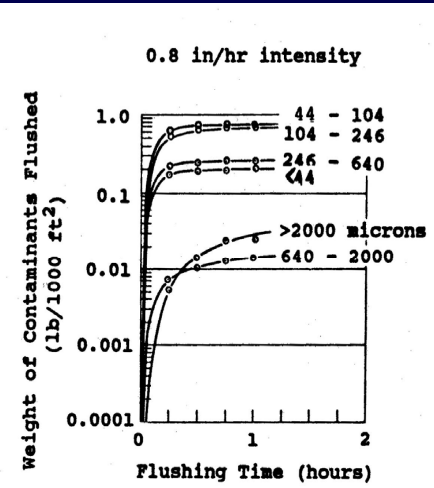
Total Solids Removal by Street Cleaning



Pitt 1979

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Original Sartor and Boyd Washoff Plot



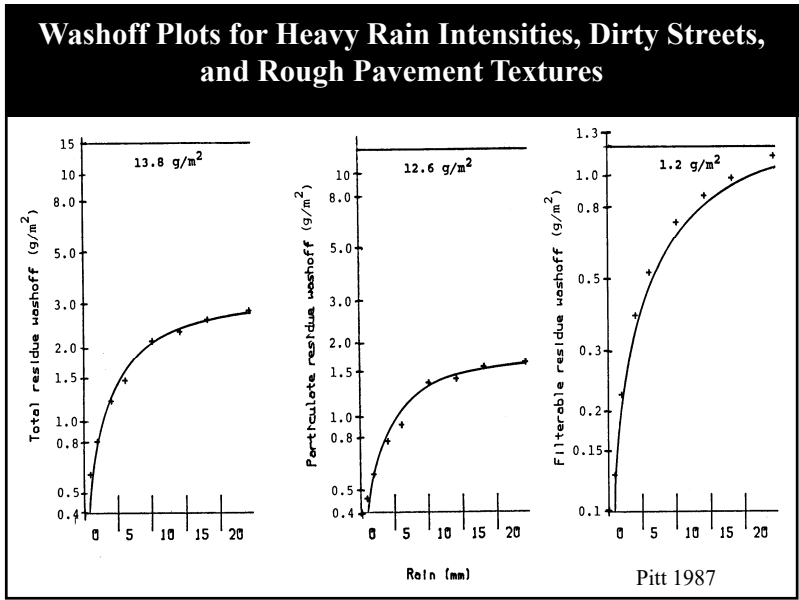
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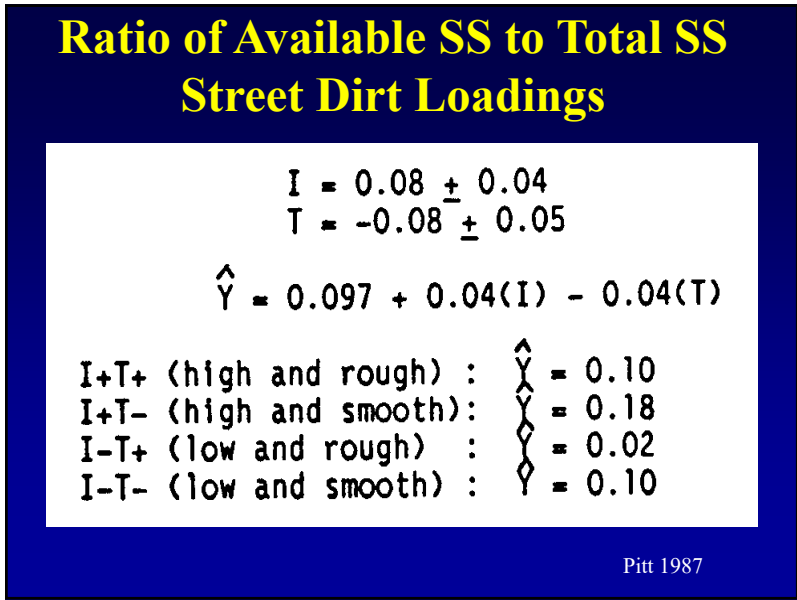
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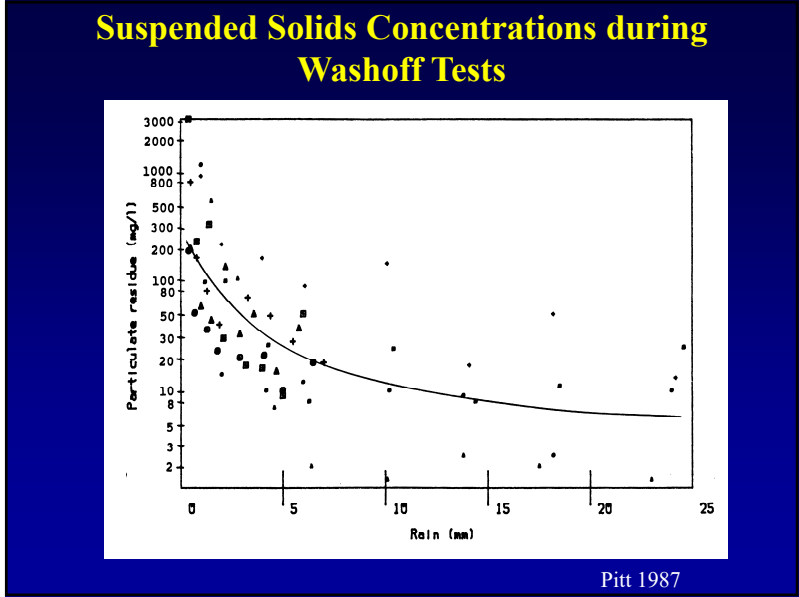
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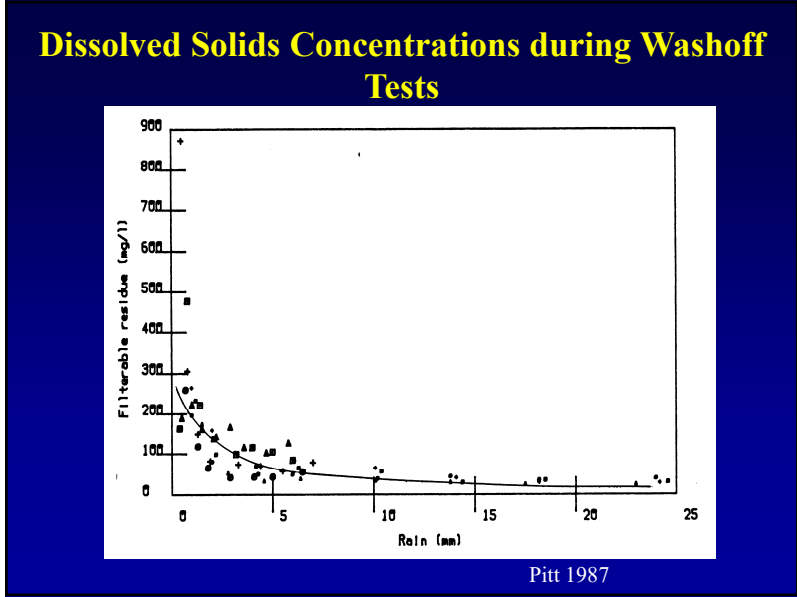
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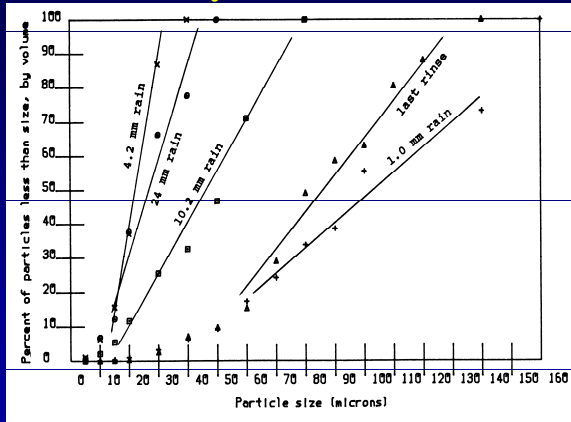


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Particle Size Distributions during Washoff Tests (high rain intensity, clean and smooth streets)



Pitt 1987

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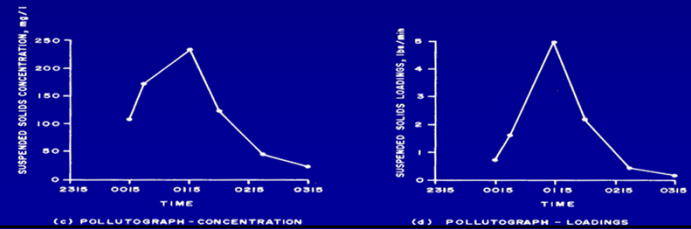


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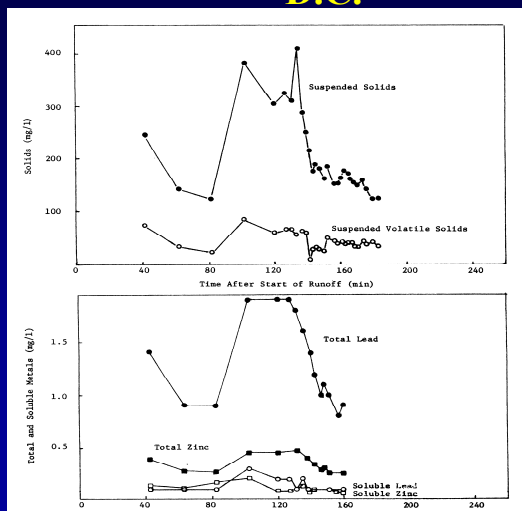
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Rain, Flow, TSS Data: U.S. Hwy 45 Site, Milwaukee, WI – March 3, 1976



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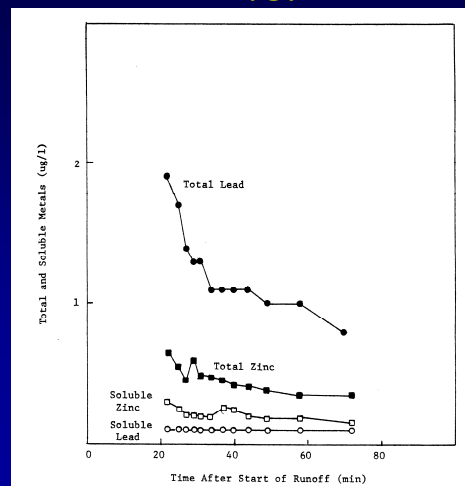
Washoff of Highway Runoff, Washington, D.C.



Shaheen 1975

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Washoff of Highway Runoff, Washington, D.C.



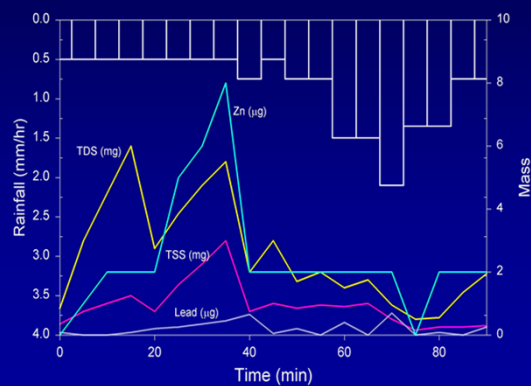
Shaheen 1975

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Rainfall vs. Washoff of Pollutants, Cincinnati, OH, USA

ADT = 150,000 (Sansalone, et al. 1996)

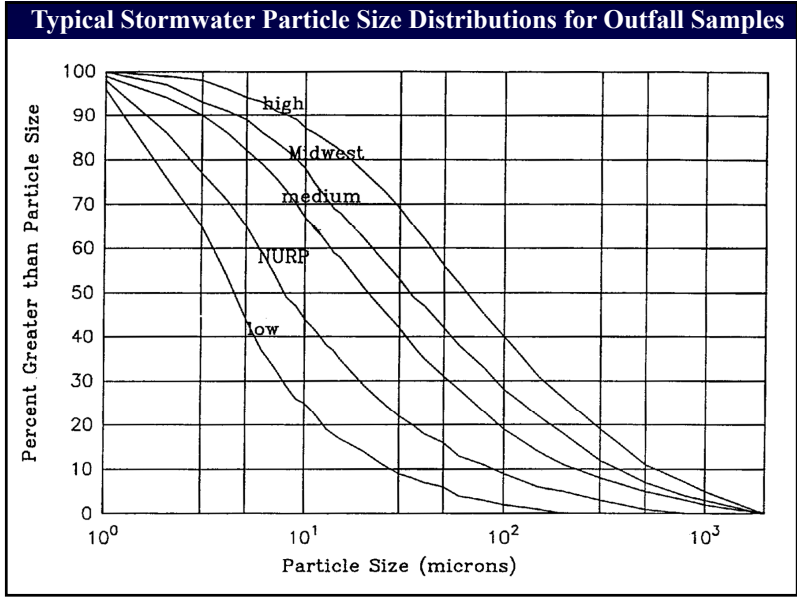
30 April 1995 Event



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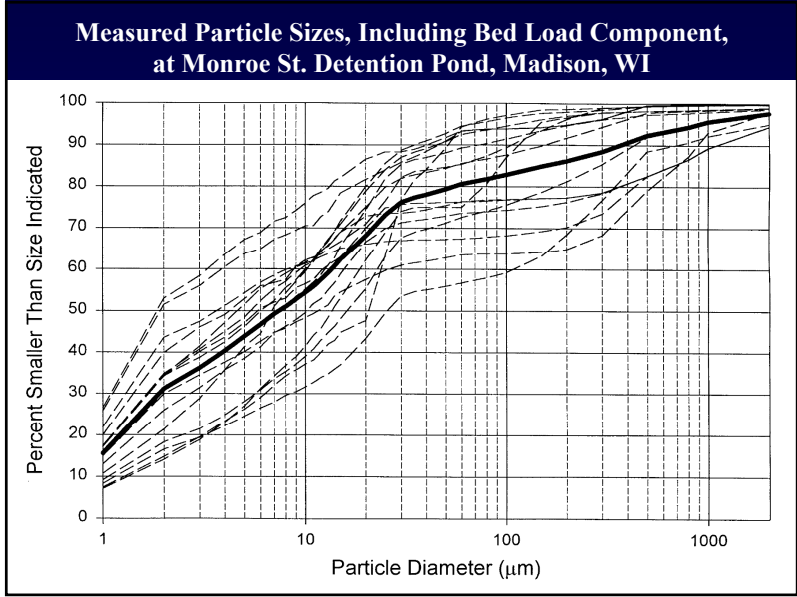
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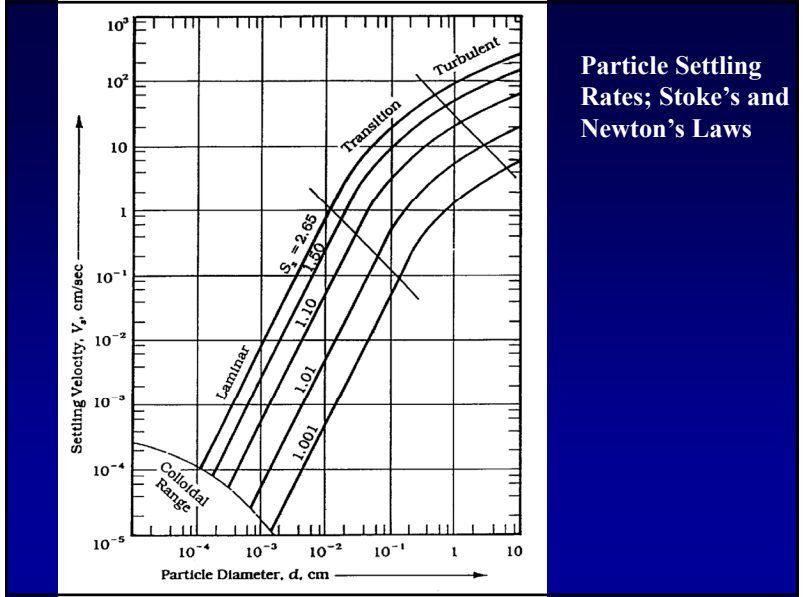
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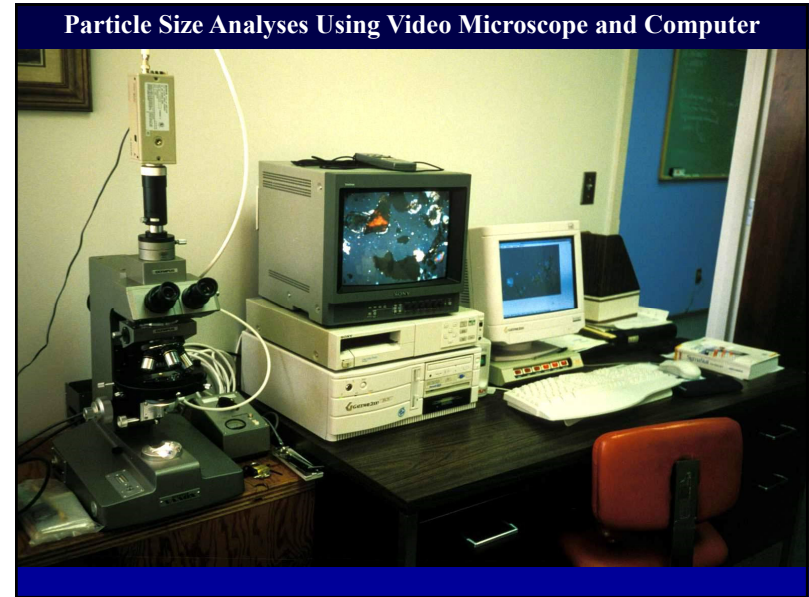
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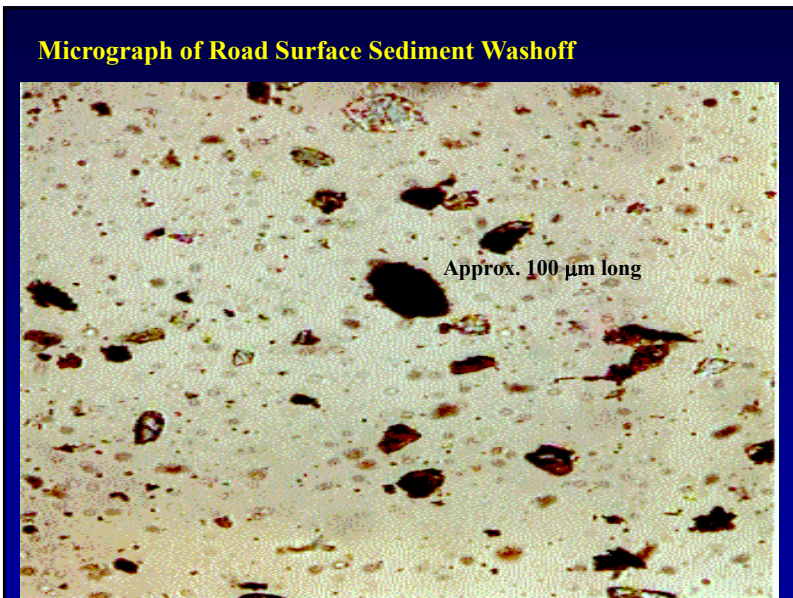
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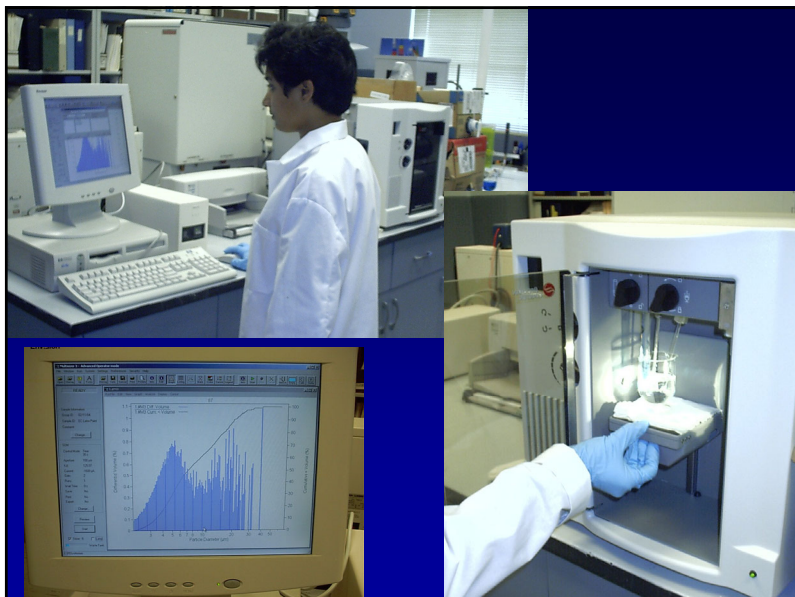
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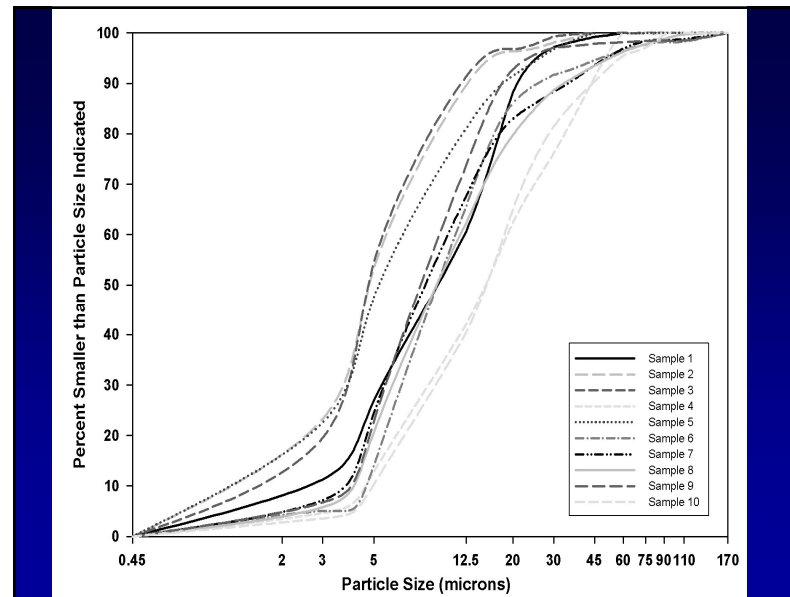
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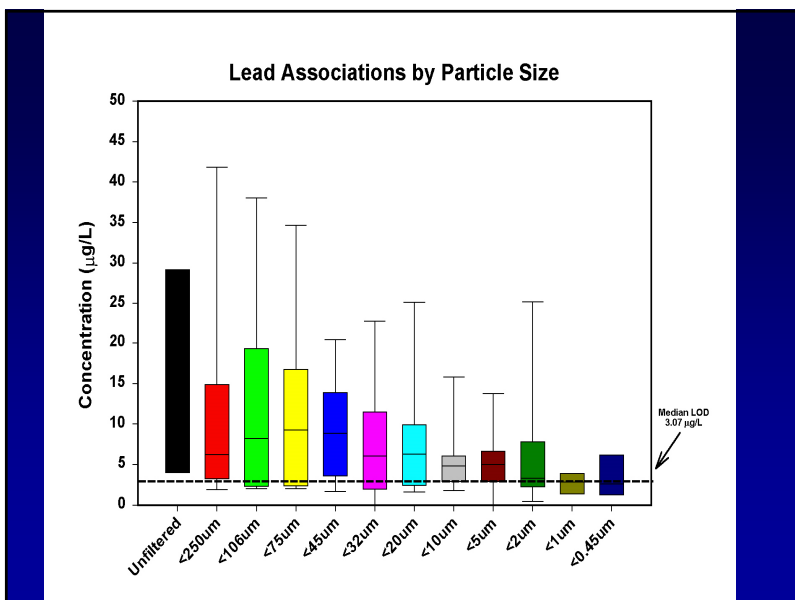
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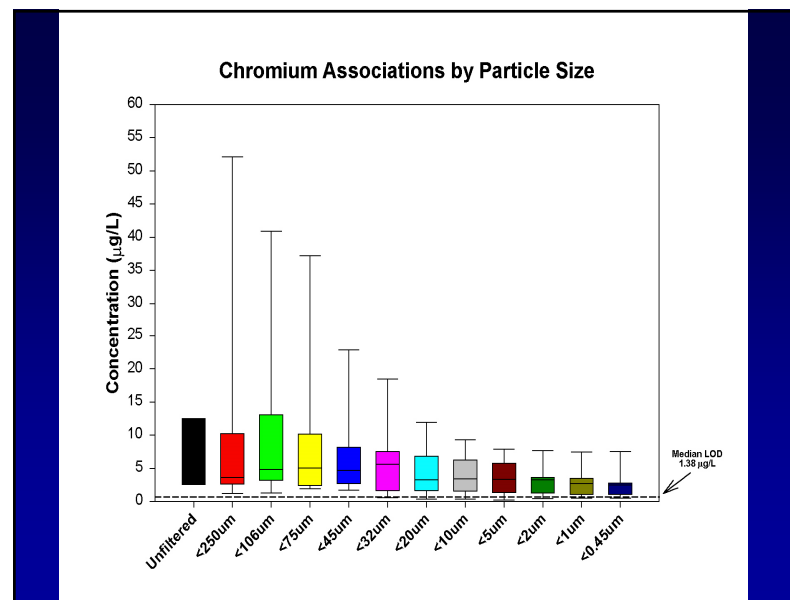
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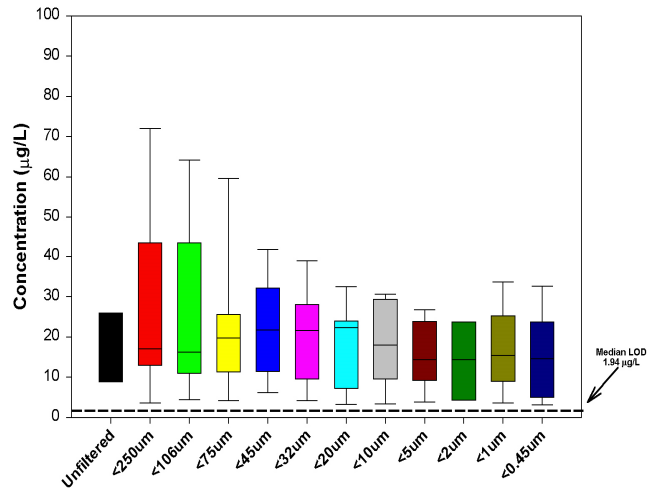


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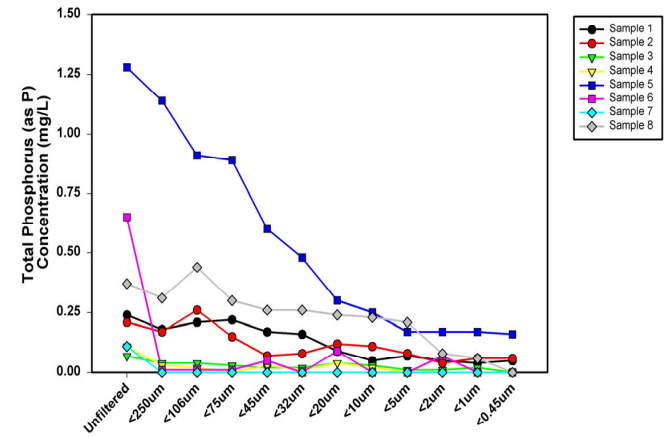
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Copper Associations by Particle Size



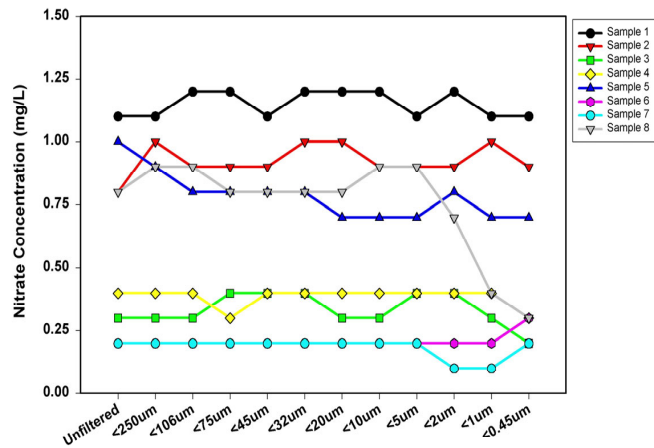
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Total Phosphorus Associations by Particle Size



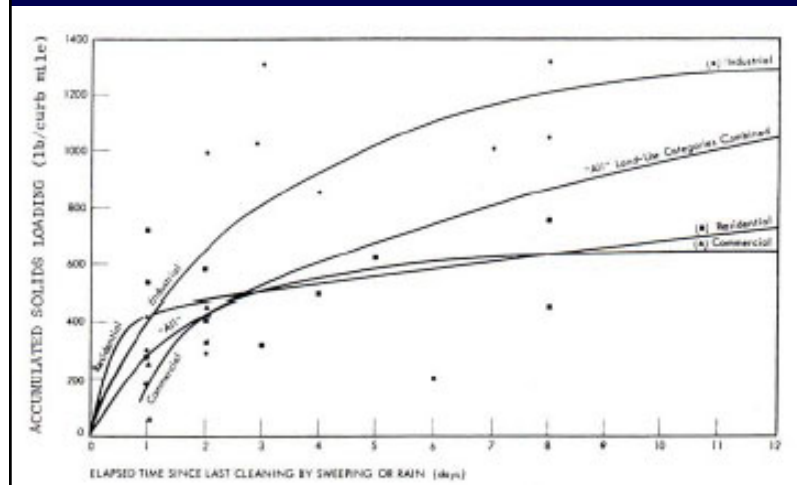
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Nitrate Associations by Particle Size



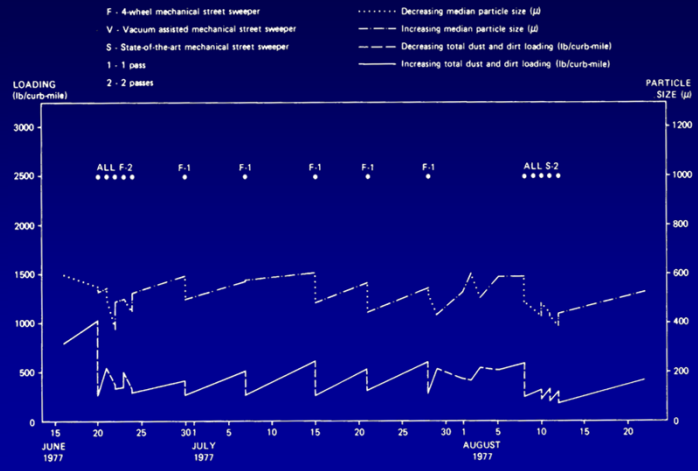
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Original Sartor and Boyd (1972) Accumulation Curves



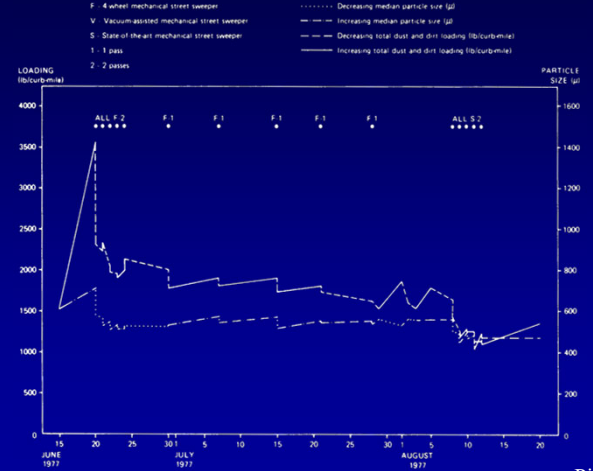
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Total Particulate Loading , Keyes – Good Asphalt Test Area



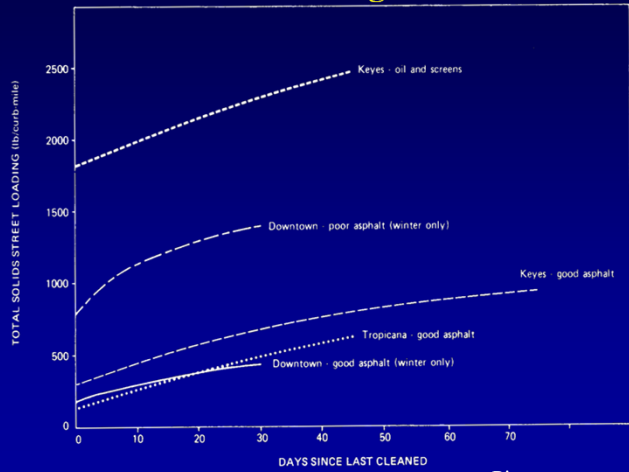
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Total Particulate Loading , Keyes – Oil and Screens Test Area



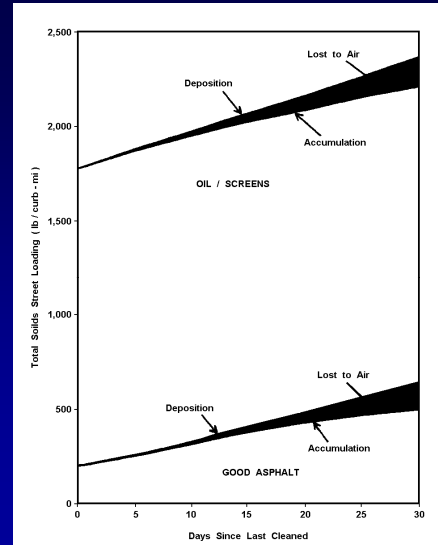
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Total Solids Accumulation Since Last Cleaning



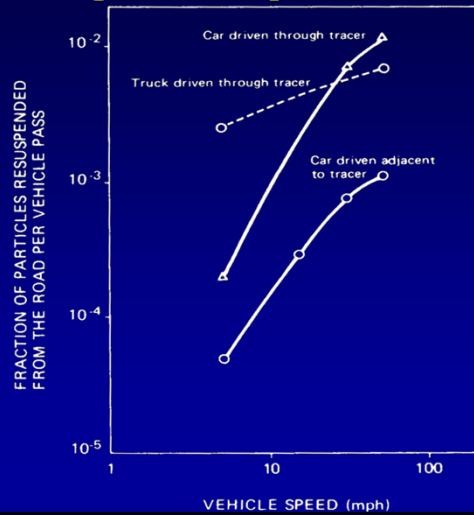
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Deposition and Accumulation of Street Dirt



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Particle Resuspension Rates Caused by Vehicle Passage for an Asphalt Road



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Measured Fugitive Dust Losses from Streets, San Jose, CA

Keyes, good asphalt	6 lb/curb-mi/day	0.33 grams/vehicle-mi
Keyes, oil and screens asphalt	4 lb/curb-mi/day	18 grams/vehicle-mi
Tropicana, good asphalt	6 lb/curb-mi/day	2.5 grams/vehicle-mi

Pitt 1979

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Example Deposition and Accumulation Rates (many studies)

	Initial load (g/m)	Depos. Rate (g/m-d)	Days to max. load
Reno, NV, smooth and good condition	80	1	5
San Jose, CA, good condition	35	4	>50
Castro Valley, CA, mod. condition	85	10	70
Ottawa, Ontario, mod. condition, indus.	60	40	>10
Toronto, Ontario, mod. condition, resid.	40	32	>10
Bellevue, WA, smooth, heavy traffic	60	1	30
San Jose, CA, oil and screens overlay	510	6	>50
Ottawa, Ontario, rough	200	20	>10

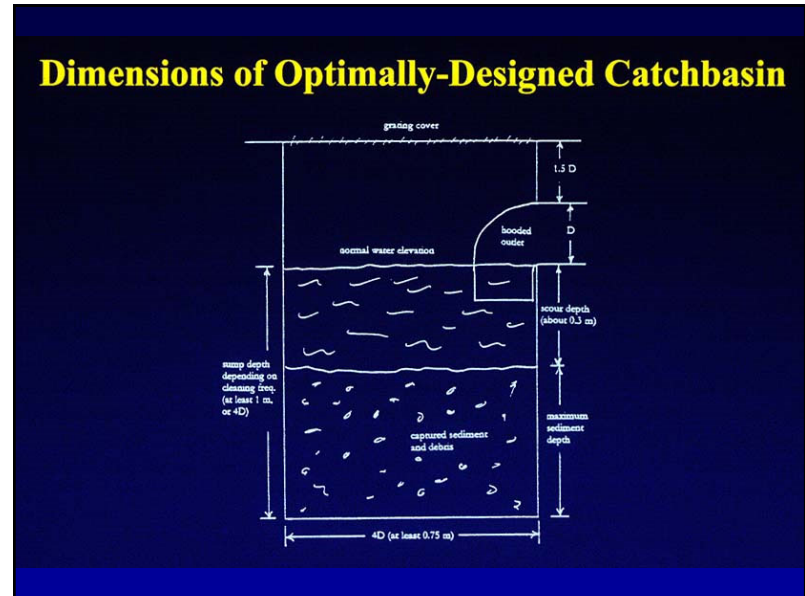
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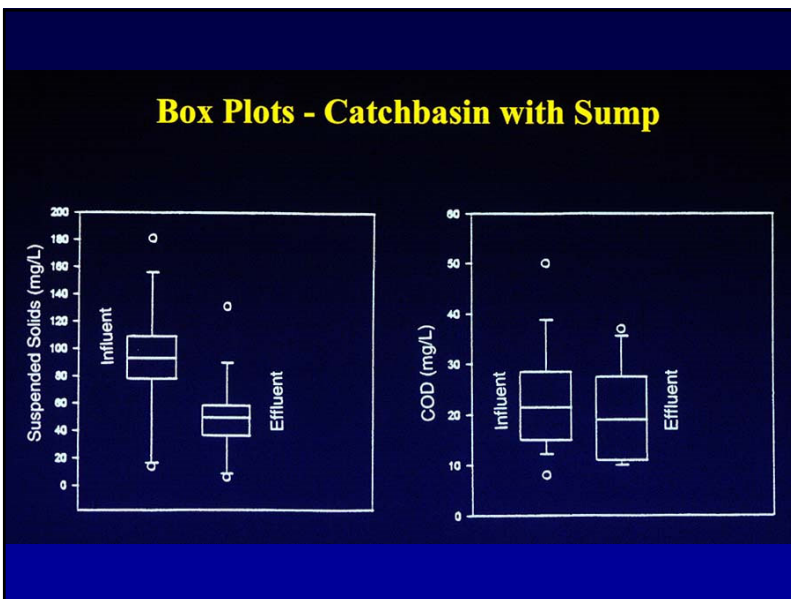
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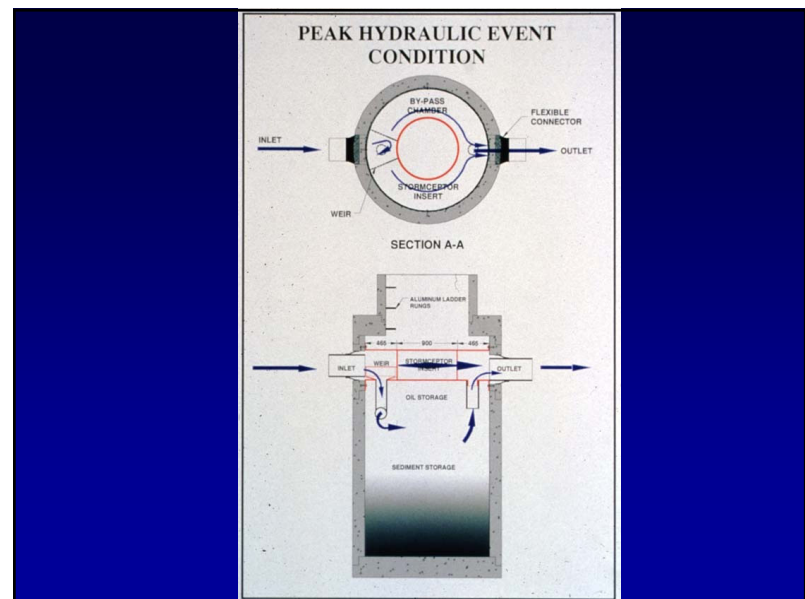
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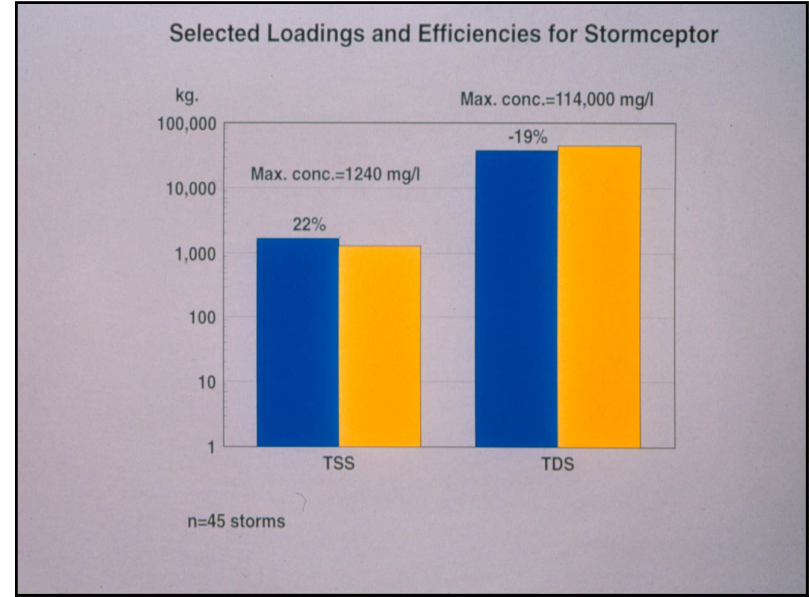
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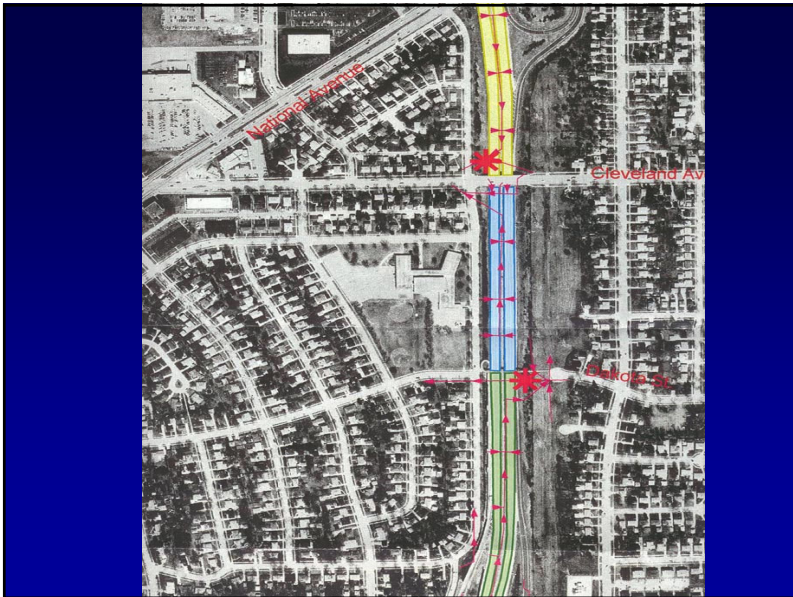
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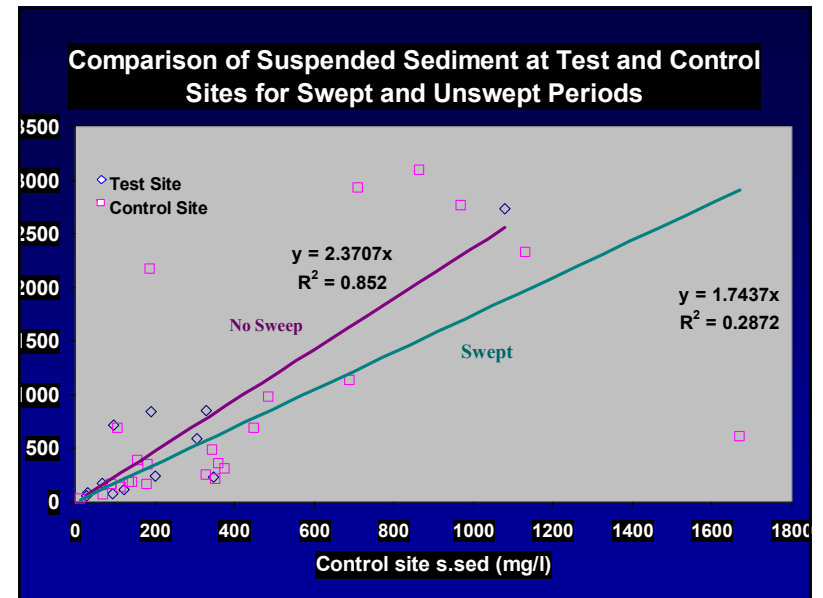
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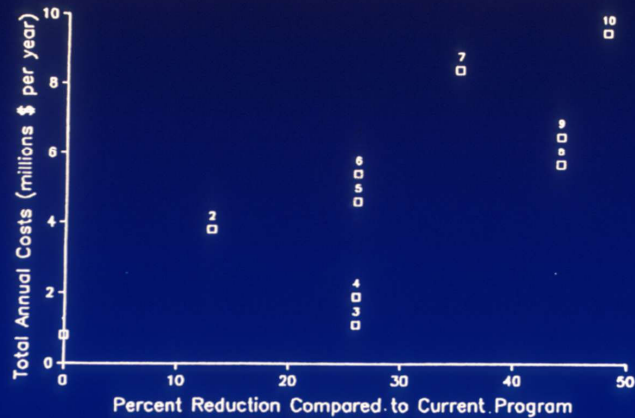


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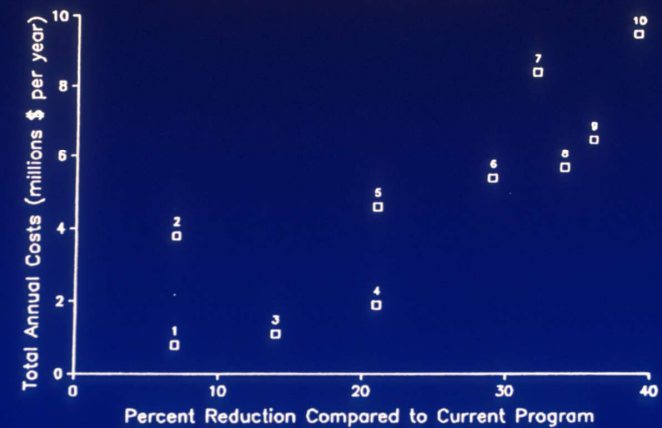
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Particulate Residue Removals for Candidate Control Programs



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Phosphorus Removals for Candidate Control Programs



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Conclusions

- Sediment in urban streams is a serious problem.
- Rains only remove a small fraction of the total particulate load from paved surfaces, mostly the smallest particles.
- Street cleaning only removes a small fraction of the street dirt loading, mostly the larger particles.
- The accumulation rate is much less than expected due to residual load.
- Particle size distributions at outfalls are mostly made up of small particles (larger particles that wash off accumulate in sewerage)
- Particle size distributions of source area sheetflows have large particles, but many of these aren't effectively transported to outfalls.
- Most models are out of balance on source area contributions.

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