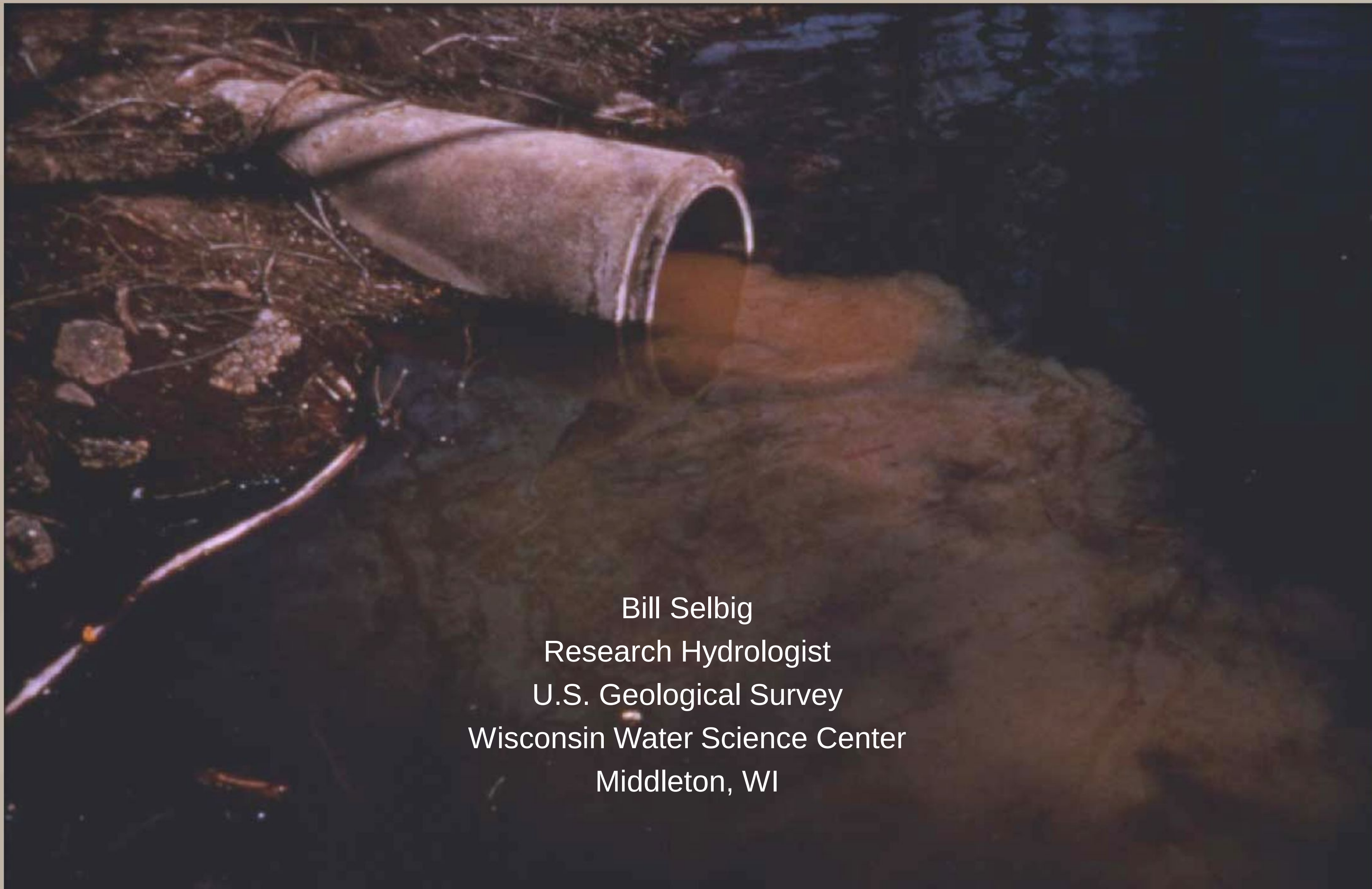
Improving Urban Stormwater Data through Use of a Depth-Integrated Sample Arm (DISA)



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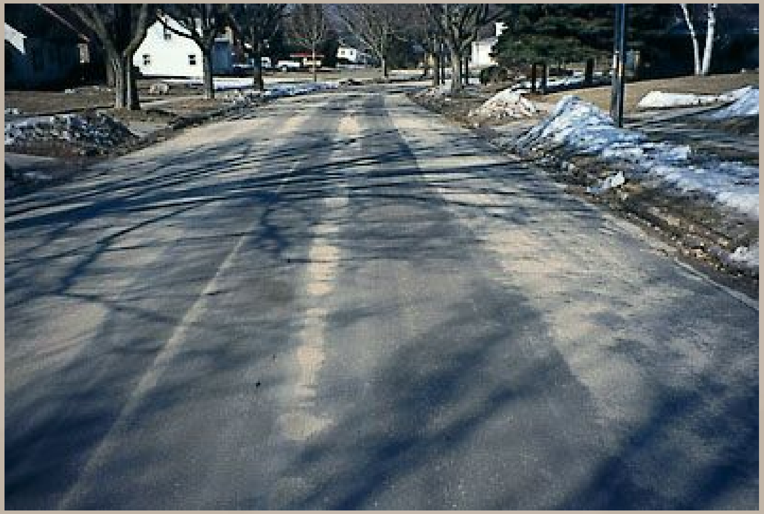
Importance of Accurate Concentration Data

- TMDLs
- Evaluation of BMPs
- Calibration and verification of hydrologic/pollutant loading models
- Design of stormwater control devices
- Development of stormwater regulation, standards, and design criteria

Challenges When Sampling Urban Runoff in Storm Sewers

- Small intake orifice in a large diameter pipe
- Difficult to get proper mixing
- Range of flows limits location of sampler intake
- Debris often inhibits good sample collection
- Concentrations biased towards bottom of water column
- High velocities prevents isokinetic sampling
- Large range of particle sizes (colloidal to trash)

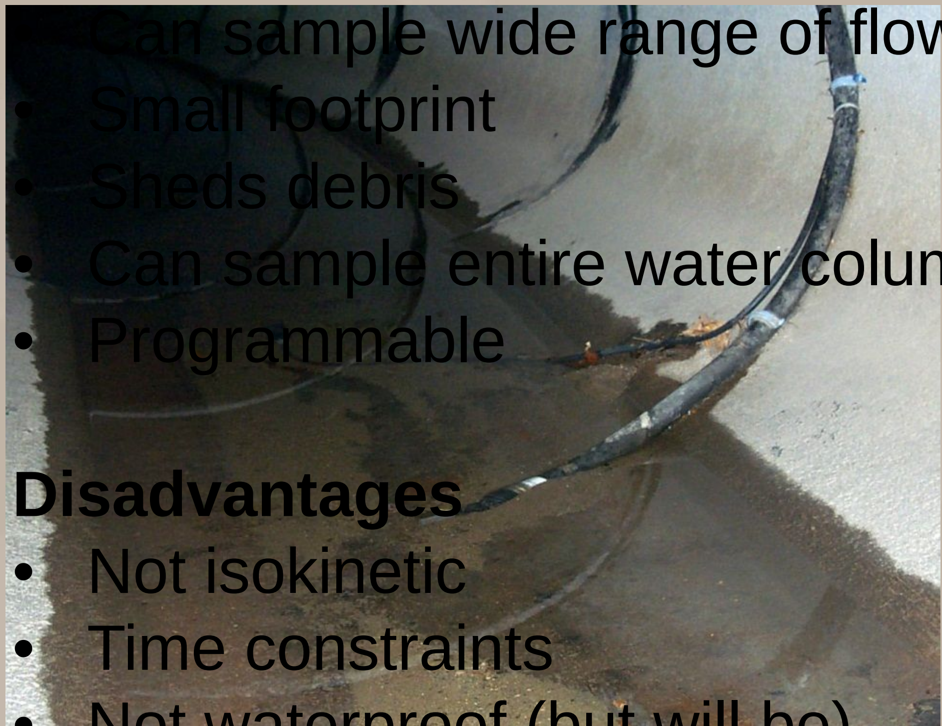


Depth Integrated Sampling Arm (DISA)

Fixed-point Sample Collection

Advantages

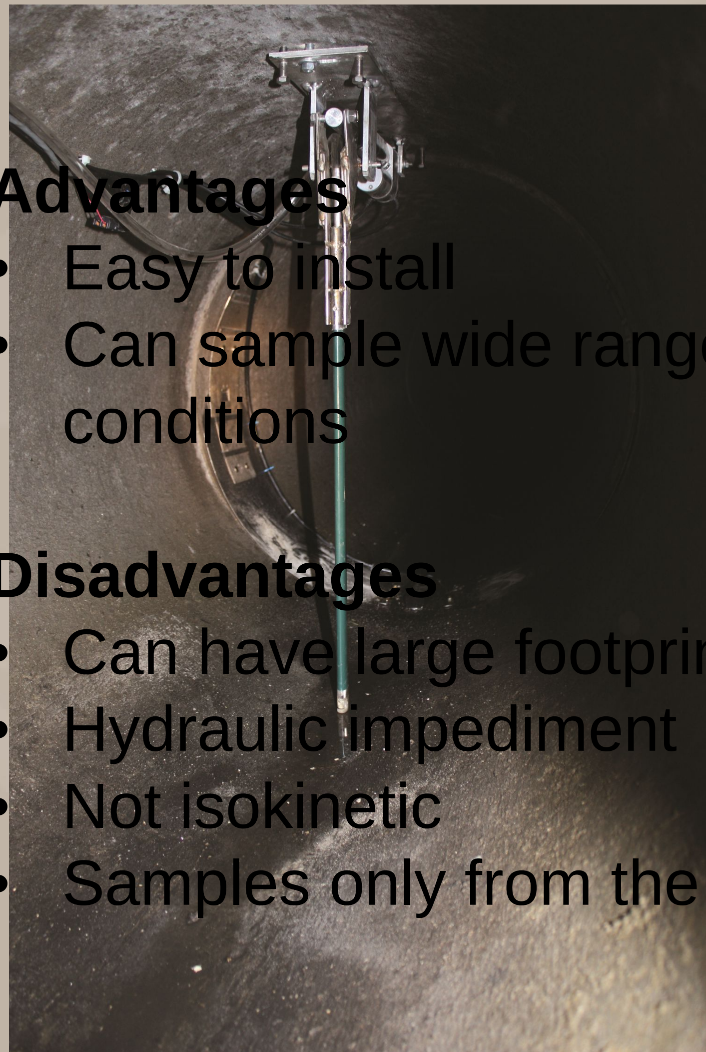
- Easy to install
- Can sample wide range of flow
- Small footprint
- Sheds debris
- Can sample entire water column
- Programmable



Disadvantages

- Not isokinetic
- Time constraints
- Not waterproof (but will be)

Depth-Integrated Sample Arm



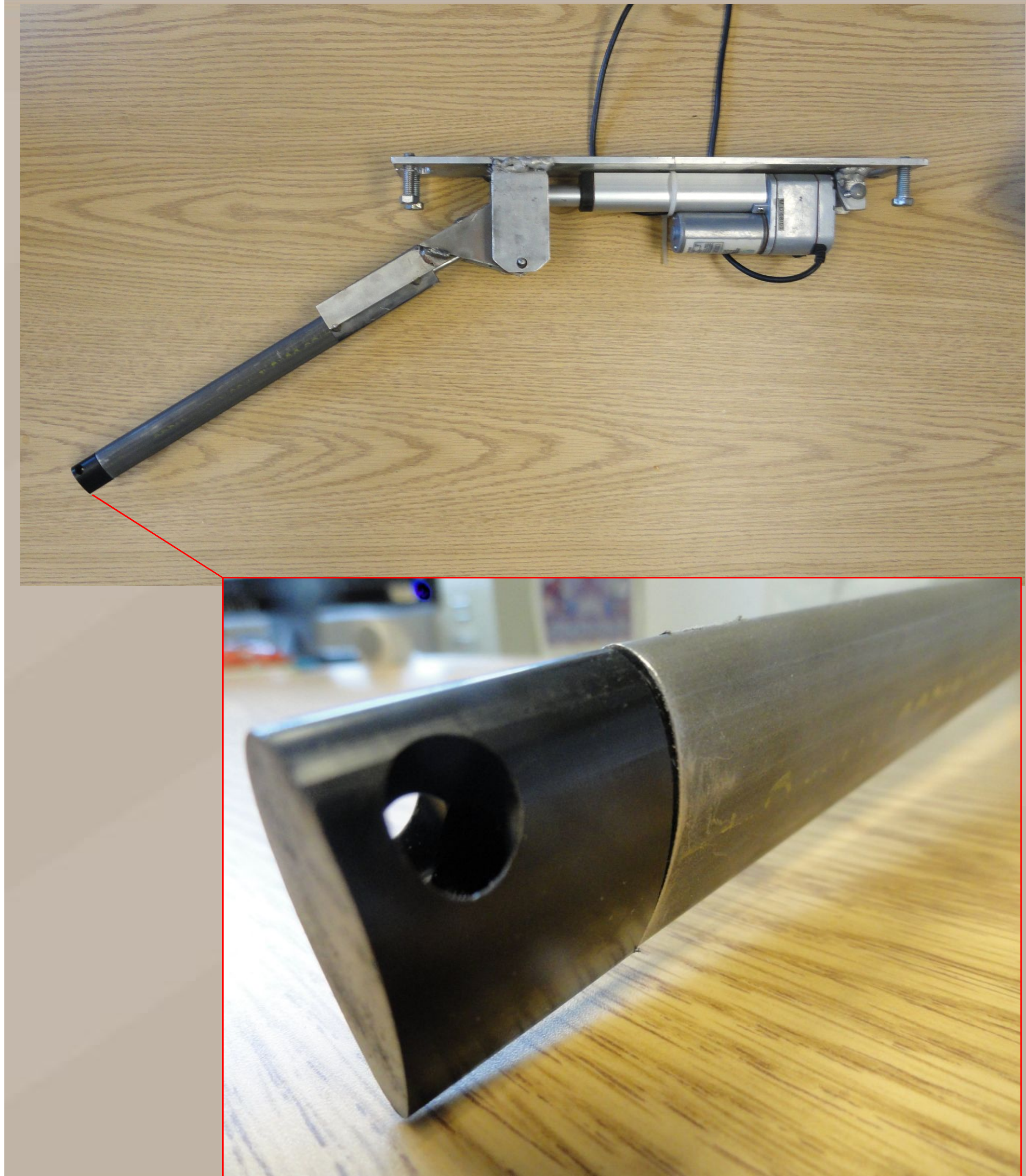
Advantages

- Easy to install
- Can sample wide range flow conditions

Disadvantages

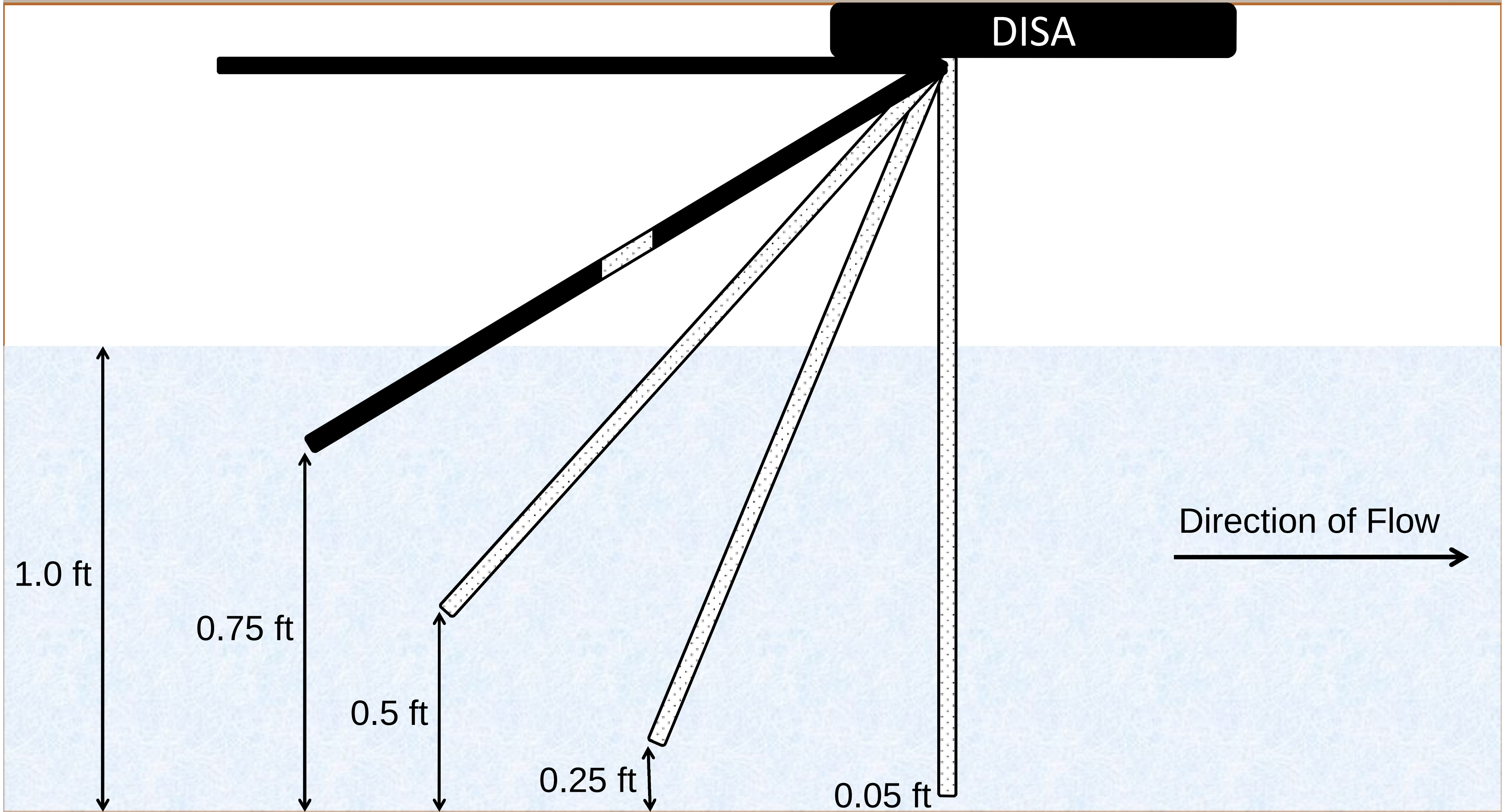
- Can have large footprint
- Hydraulic impediment
- Not isokinetic
- Samples only from the bottom

DISA - Up Close and in Action

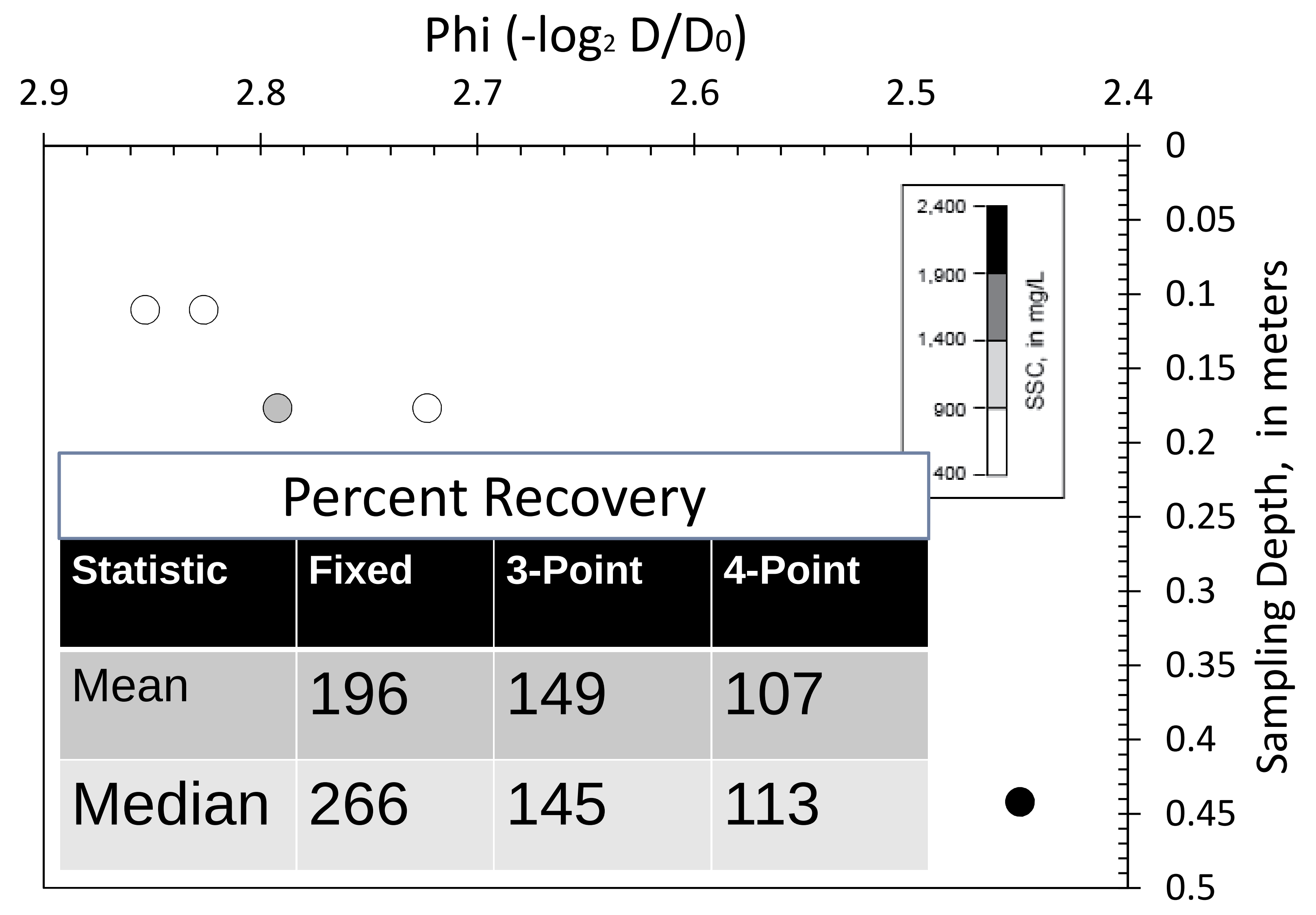


YouTube video

4-point Sample Collection



Laboratory Testing at Colorado State University

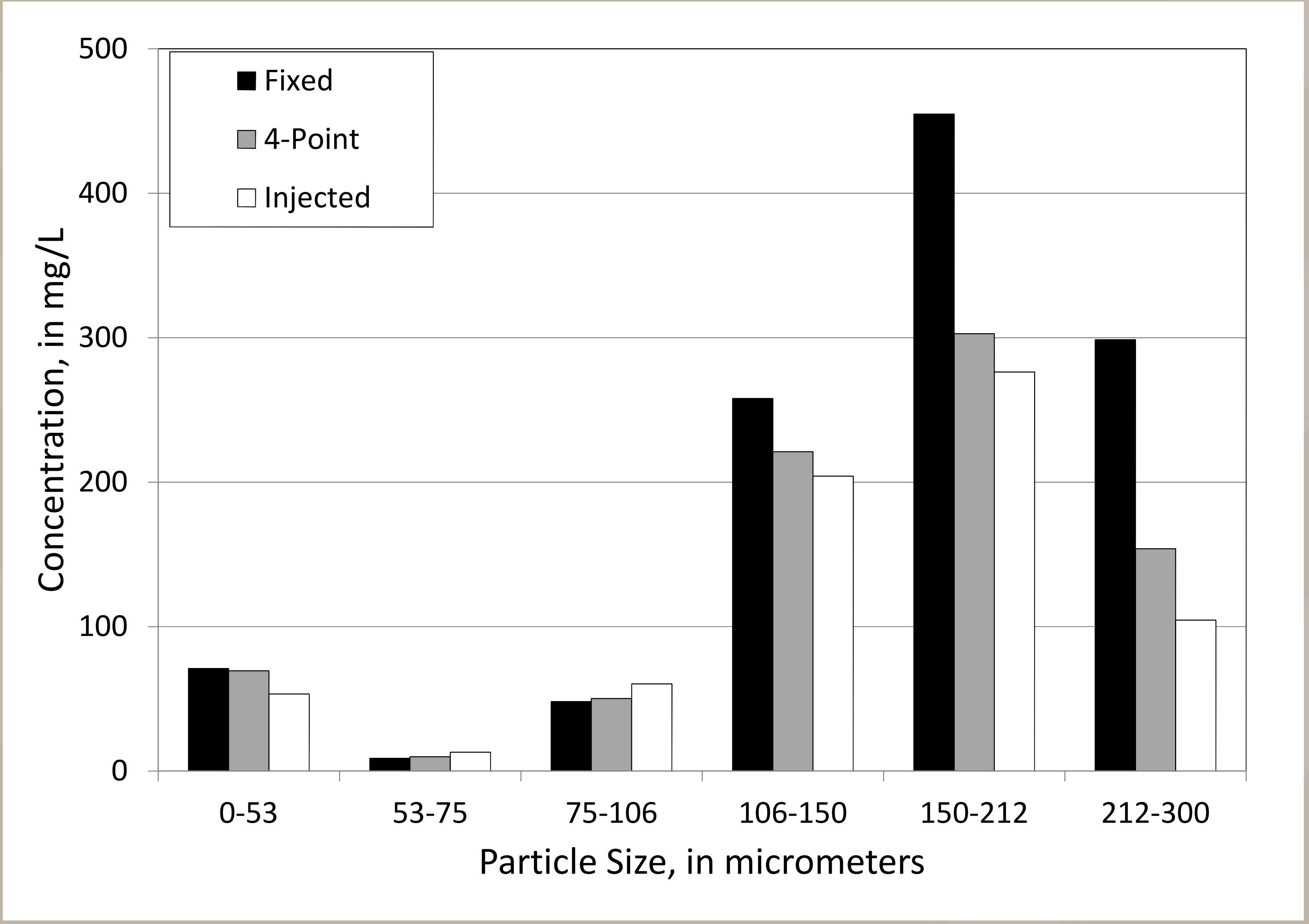


Percent Recovery

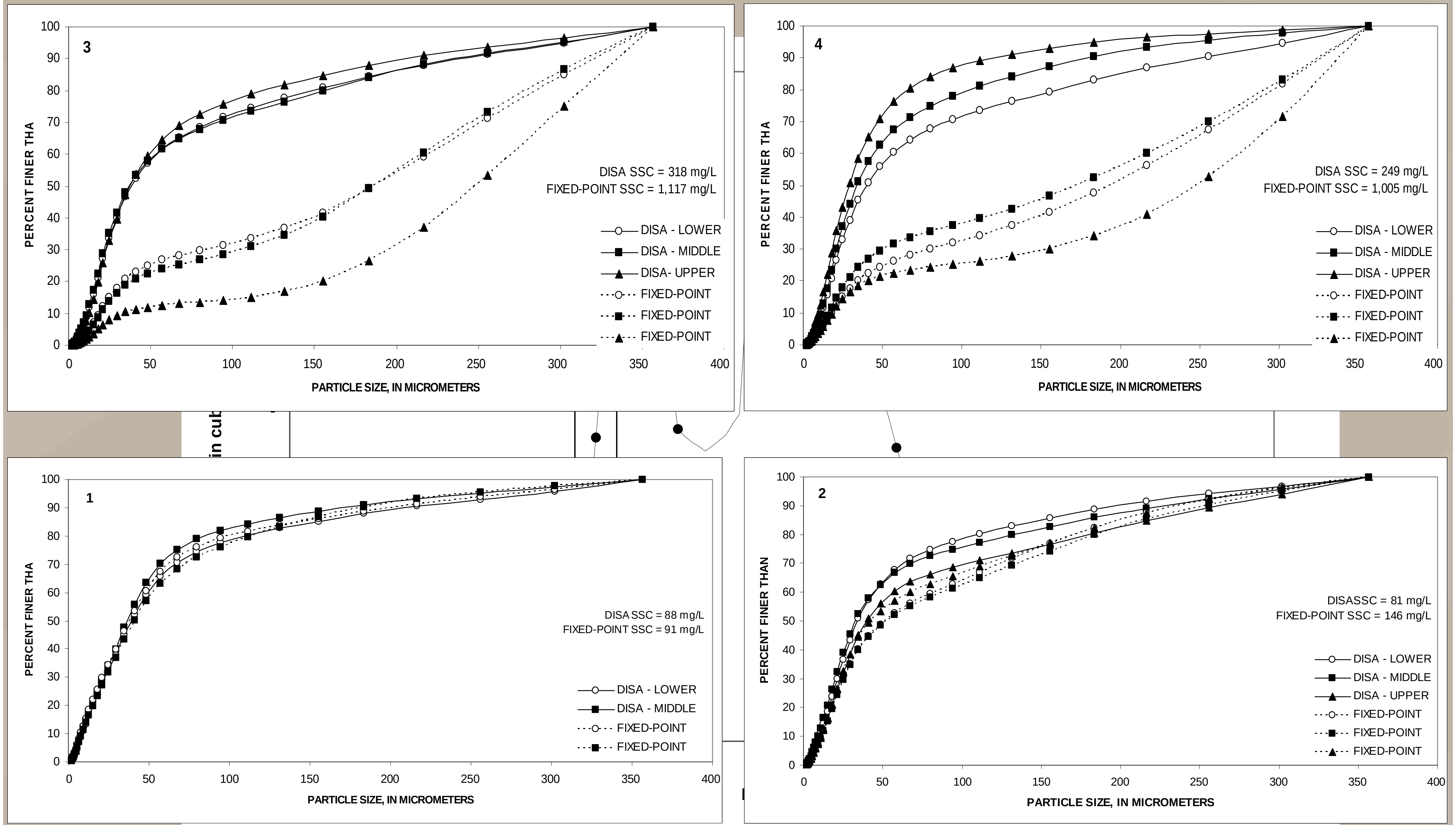
Statistic	Fixed	3-Point	4-Point
Mean	196	149	107
Median	266	145	113

Phi = -$\log_2$ (D/D_0); where: D = particle diameter, D_0 = reference diameter (equal to 1mm)

Laboratory Testing at Colorado State University



Field Testing – Madison, Wisconsin



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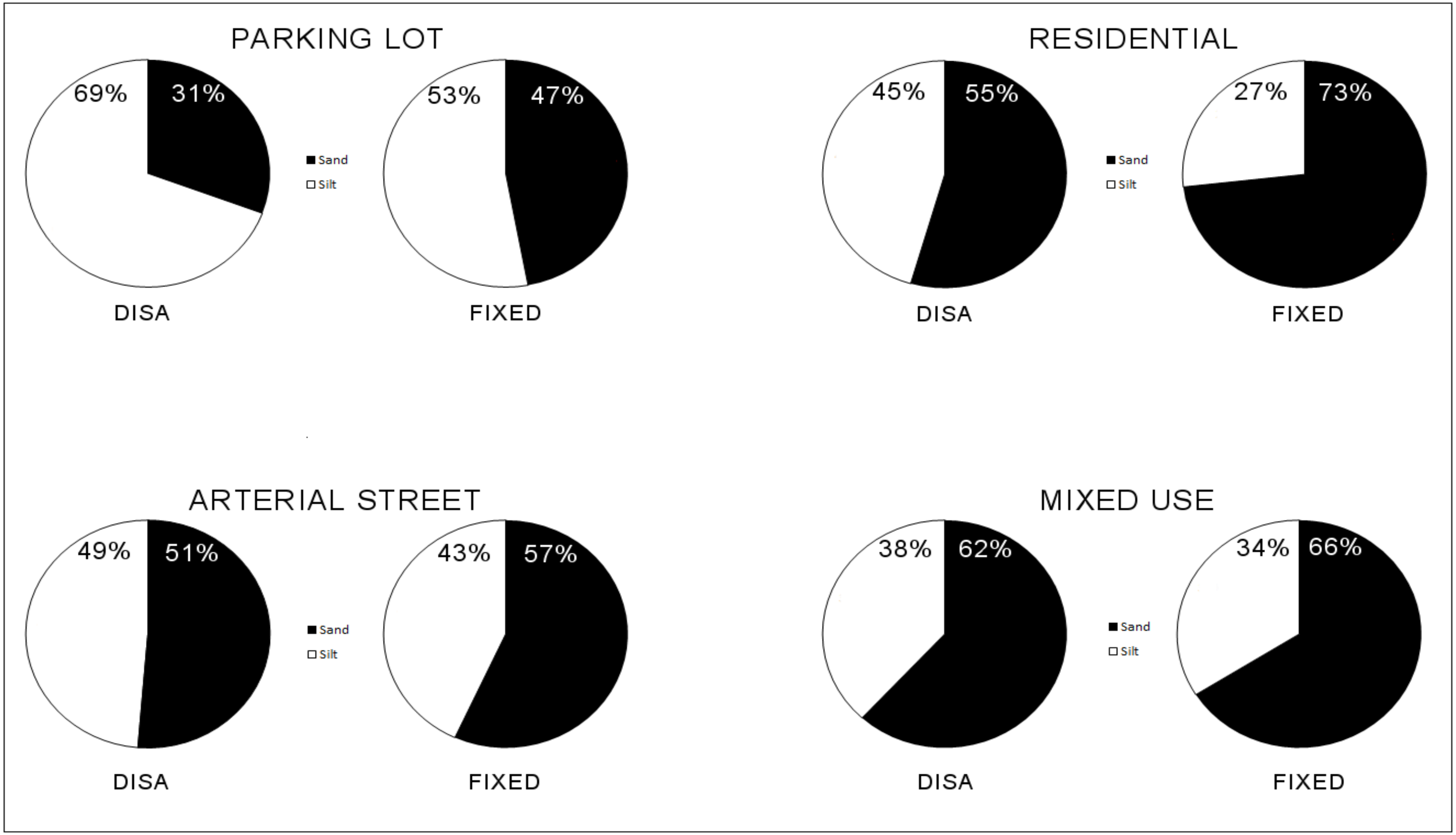
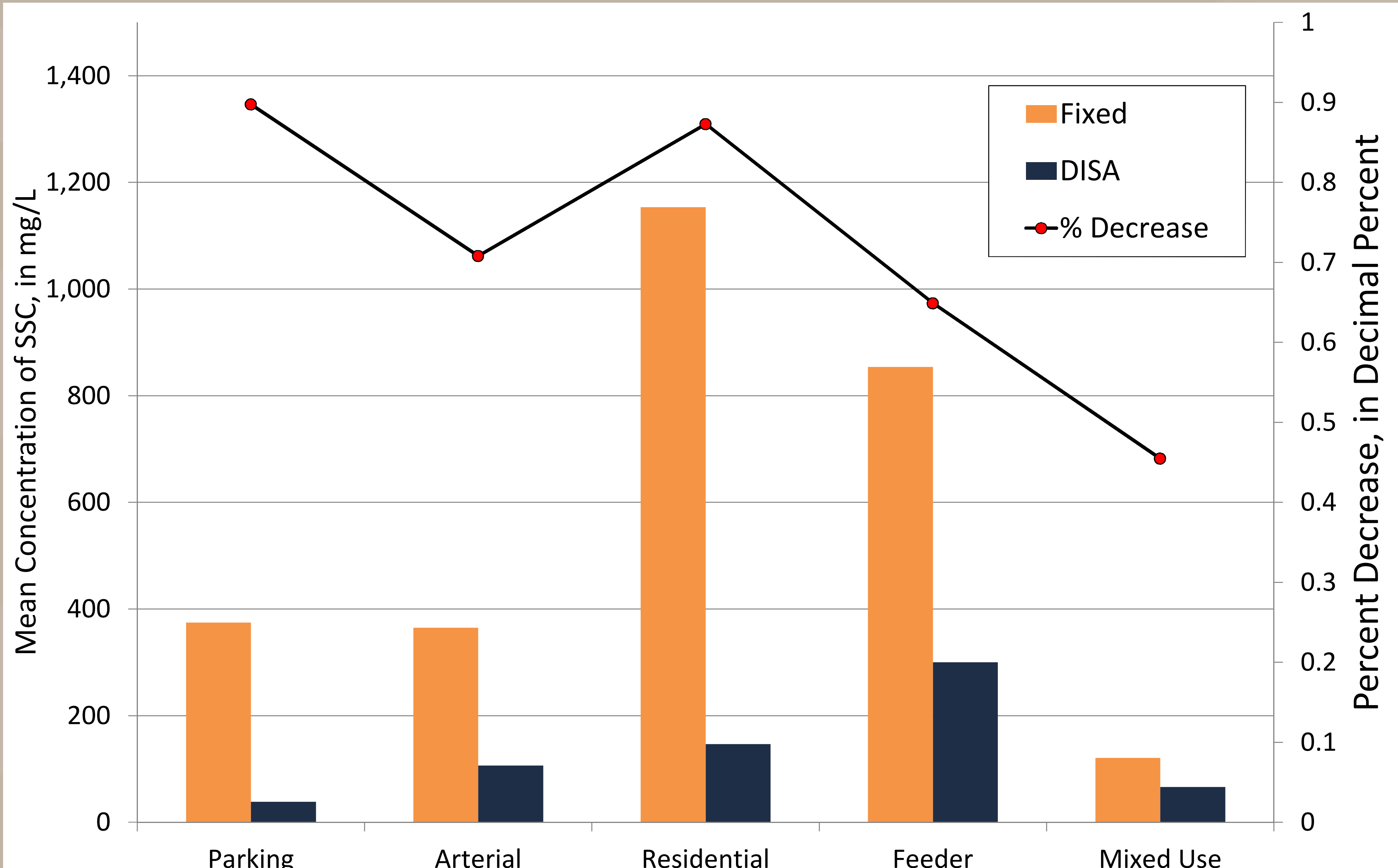
Median sand and silt in samples using DISA and fixed-point



Field Testing – Madison, Wisconsin



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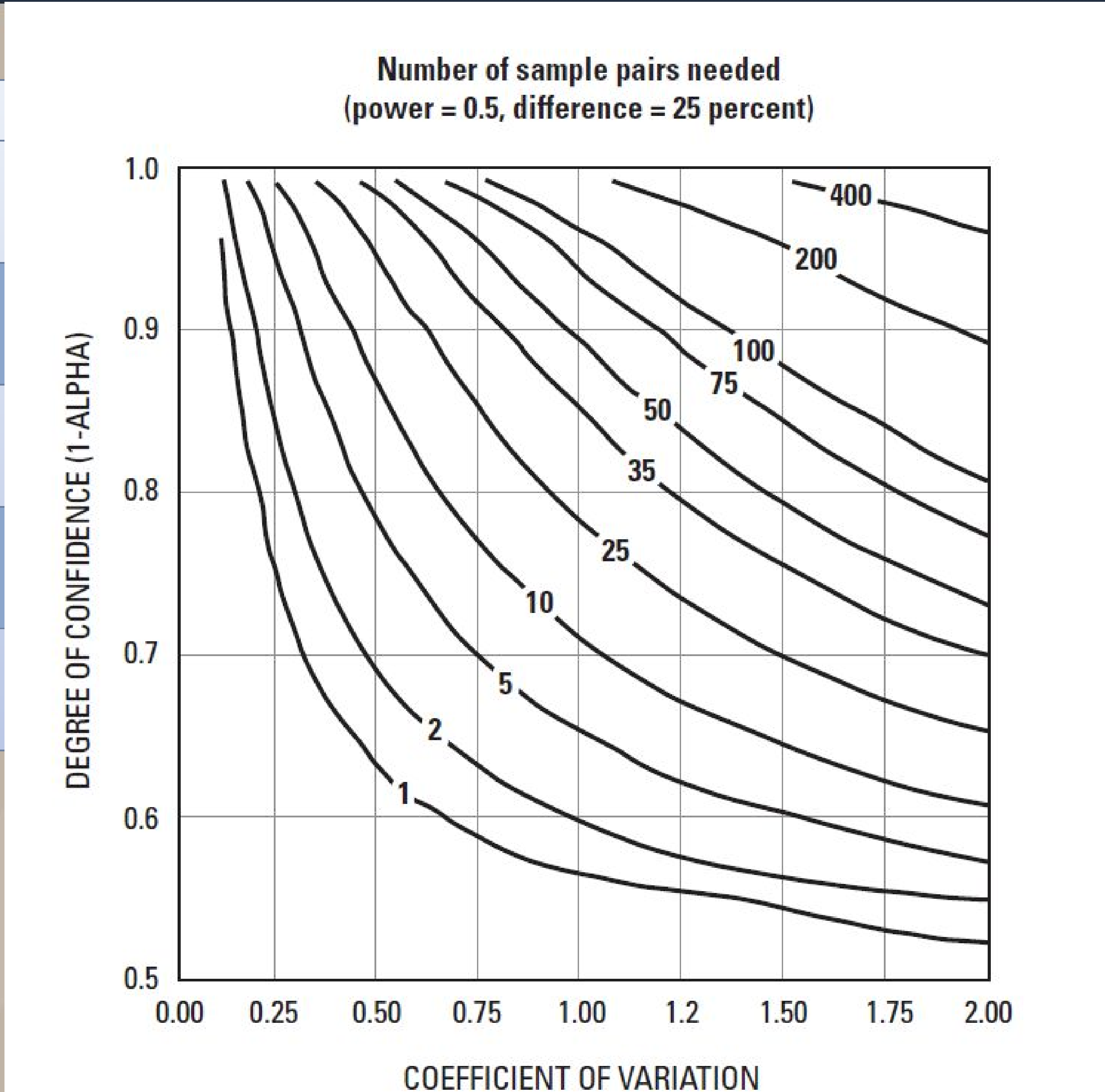
Less Variability = Better results with Fewer Data



From Burton and Pitt (2002)

ean	Min	Max	STD	COV
75	11	4,952	1,001	2.7
38	7	140	35	0.9
65	14	5,110	831	2.3
07	23	250	75	0.7
154	125	5,119	1,467	1.3
47	49	477	113	0.8
54	44	9,170	2,062	2.4
00	10	1,070	308	0.9
21	11	370	123	1.0
56	15	150	40	0.6

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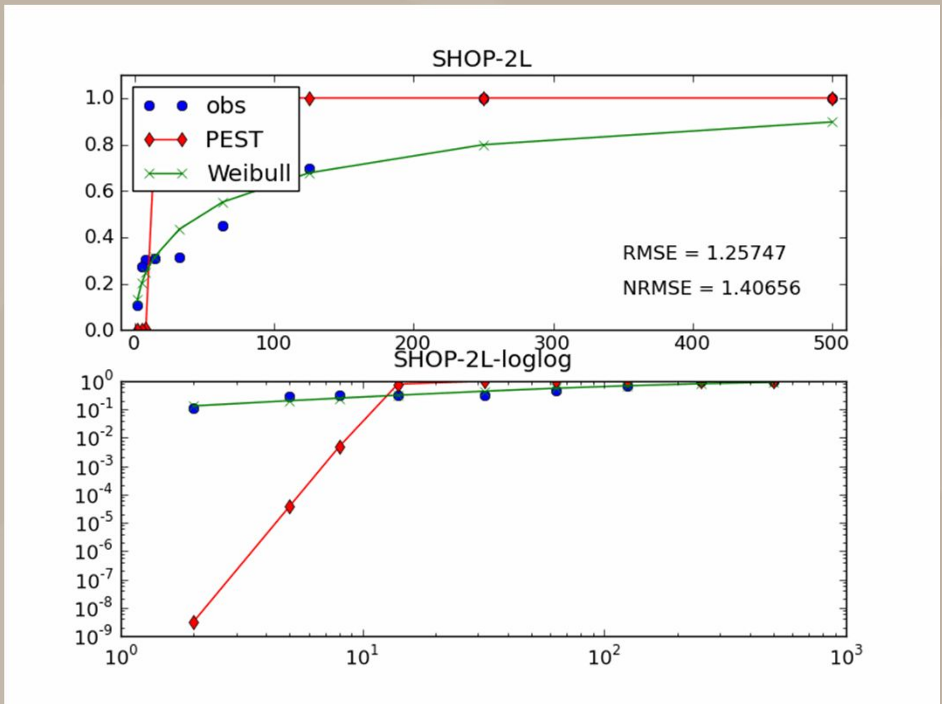
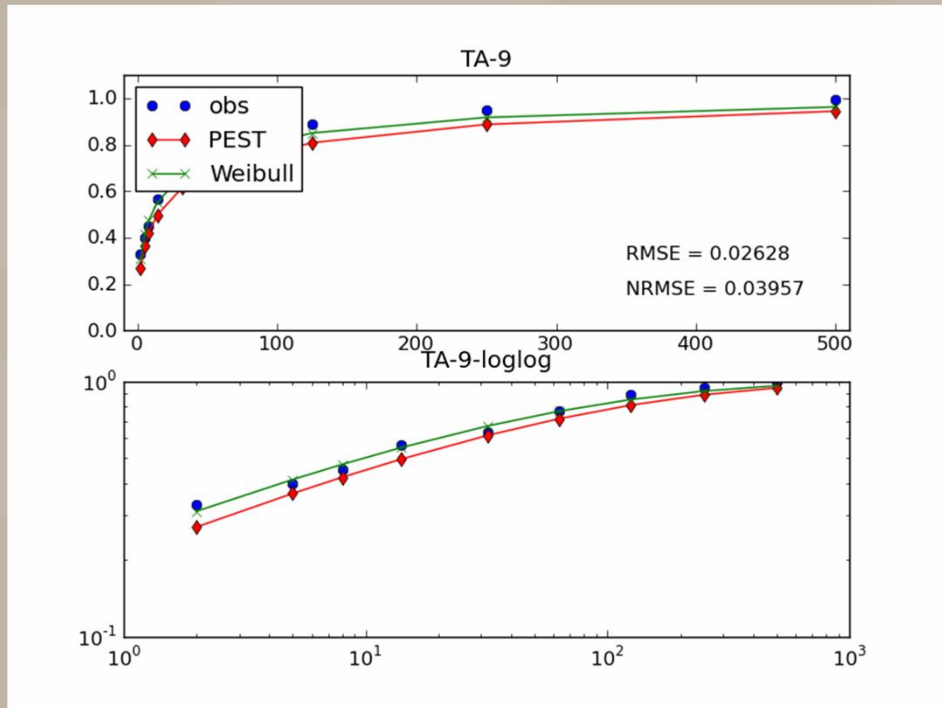
Application – Predicting Particle Size Distribution Using Environmental Variables

Fixed-point



DISA



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Future Modifications and Applications

Modifications

- Waterproof casing
- Open channel testing
- Variable-speed actuator
- Miniaturization
- Sediment-associated pollutant bias?

Applications

- Improved trend detection
- Improved regressions of pollutants to predictors
- Cost analysis

Publications / Questions

Funding Provided by:

- Wisconsin Department of Natural Resources
- USGS – Office of Water Quality
- Federal Interagency Sedimentation Program (FISP)

- Selbig, W.R., and Bannerman, R.T., 2011, Development of a Depth-integrated Sampler Arm (DISA) to Reduce Solids Stratification Bias in Stormwater Sampling, *Water Environment Research* , v. 83, no. 4, pp. 347-357..
- Selbig, W.R., 2011, Characterizing the size distribution of particles in urban stormwater by use of fixed-point sample-collection methods, U.S Geological Survey Open-File Report 2011-1052, 14p.
- Selbig, W.R., and Fienen, M.N., 2011, Regression modeling of particle size distributions in urban stormwater: advancements through improved sample collection methods, *Journal of Environmental Engineering*, in review.
- Selbig, W.R., Cox, A., and Bannerman, R.T., 2012, Verification of a depth-integrated sample arm as a means to reduce solids stratification bias in urban stormwater sampling, *Journal of Environmental Monitoring* 14(4), pp. 1137-1143.