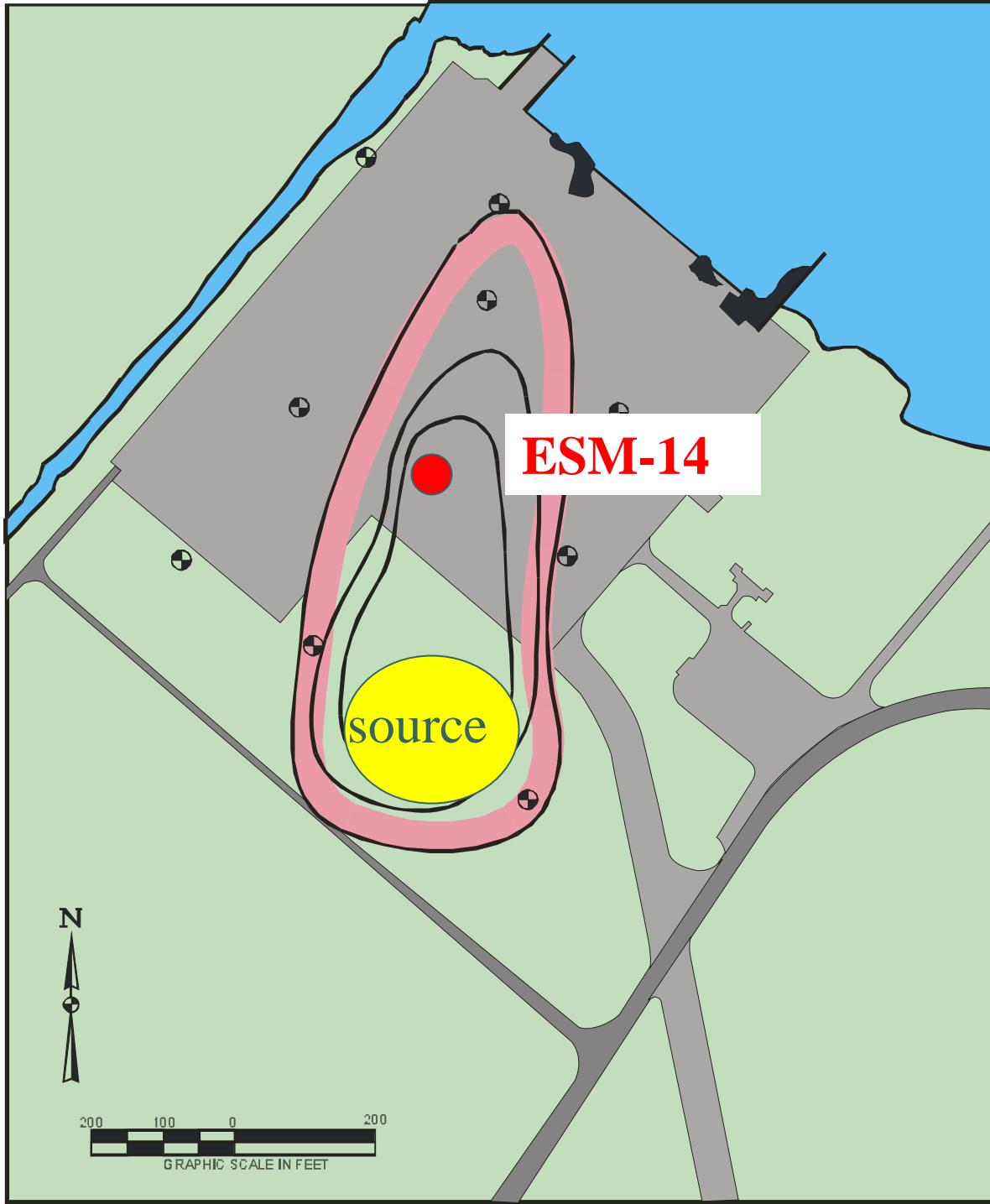


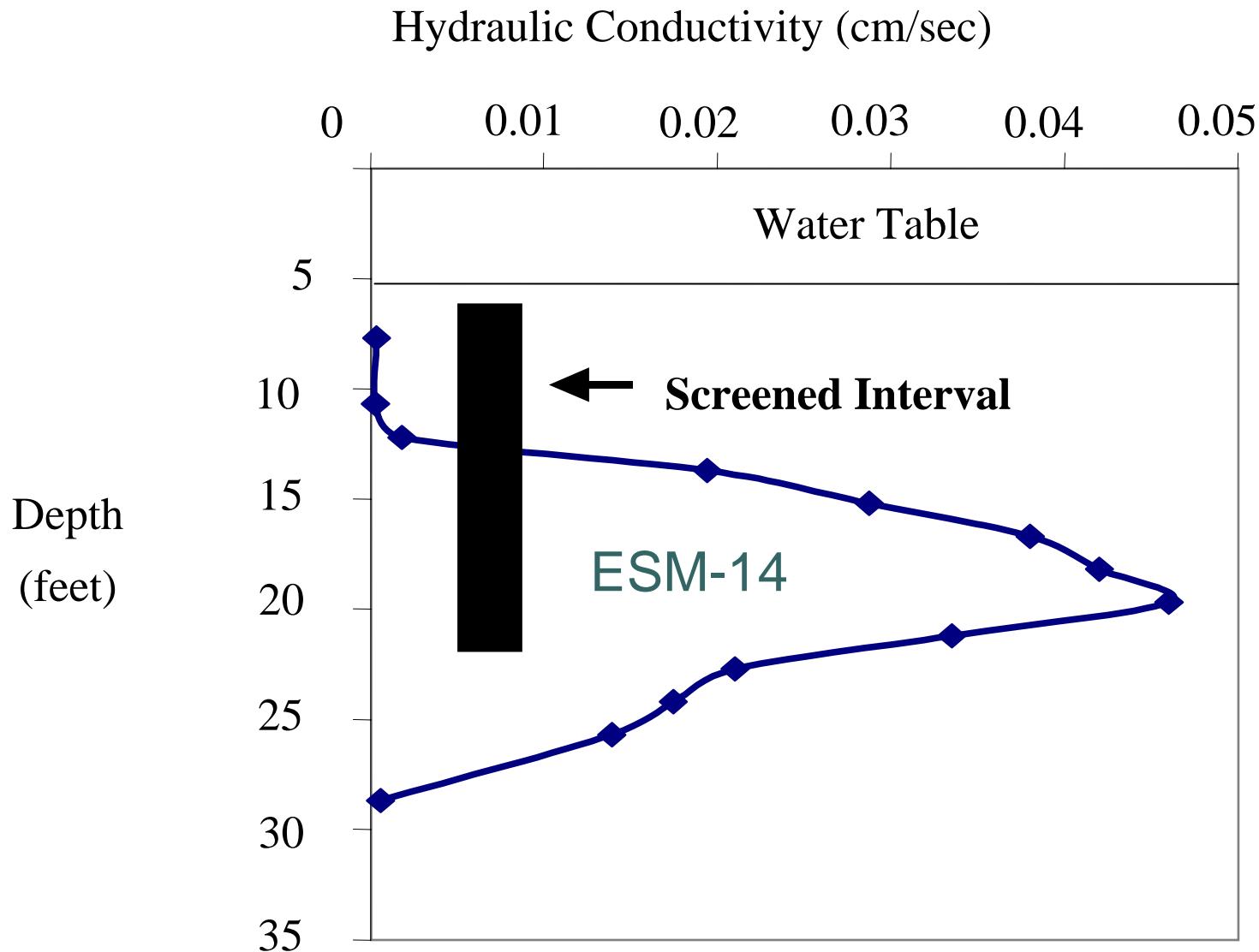
Ground Water Monitoring and Sampling: Multi-Level Versus Traditional Methods

Cynthia J. Paul and John Wilson

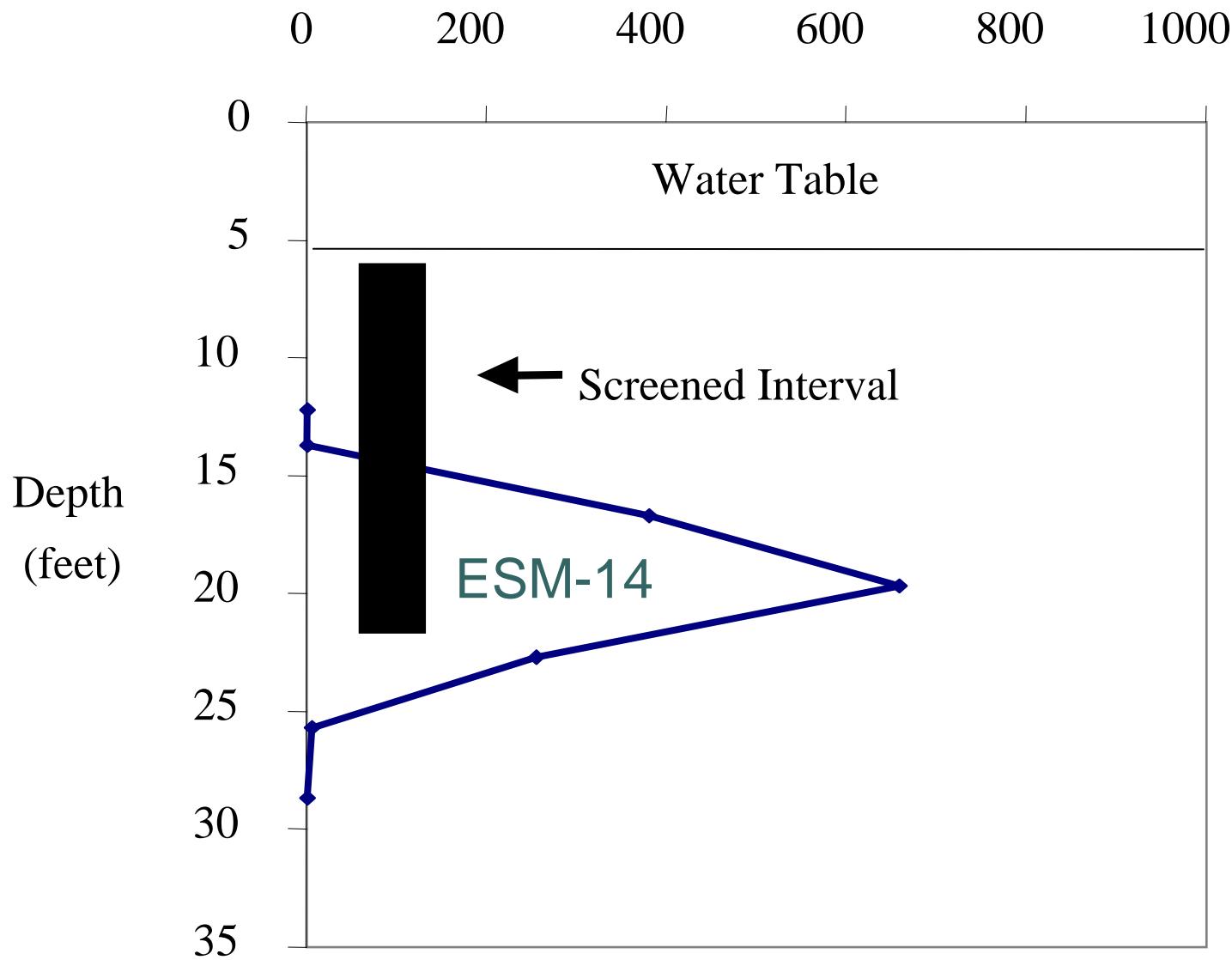
U.S. EPA Office of Research and Development
National Risk Management Research Laboratory
Ground Water & Ecosystems Research Laboratory
Ada, OK

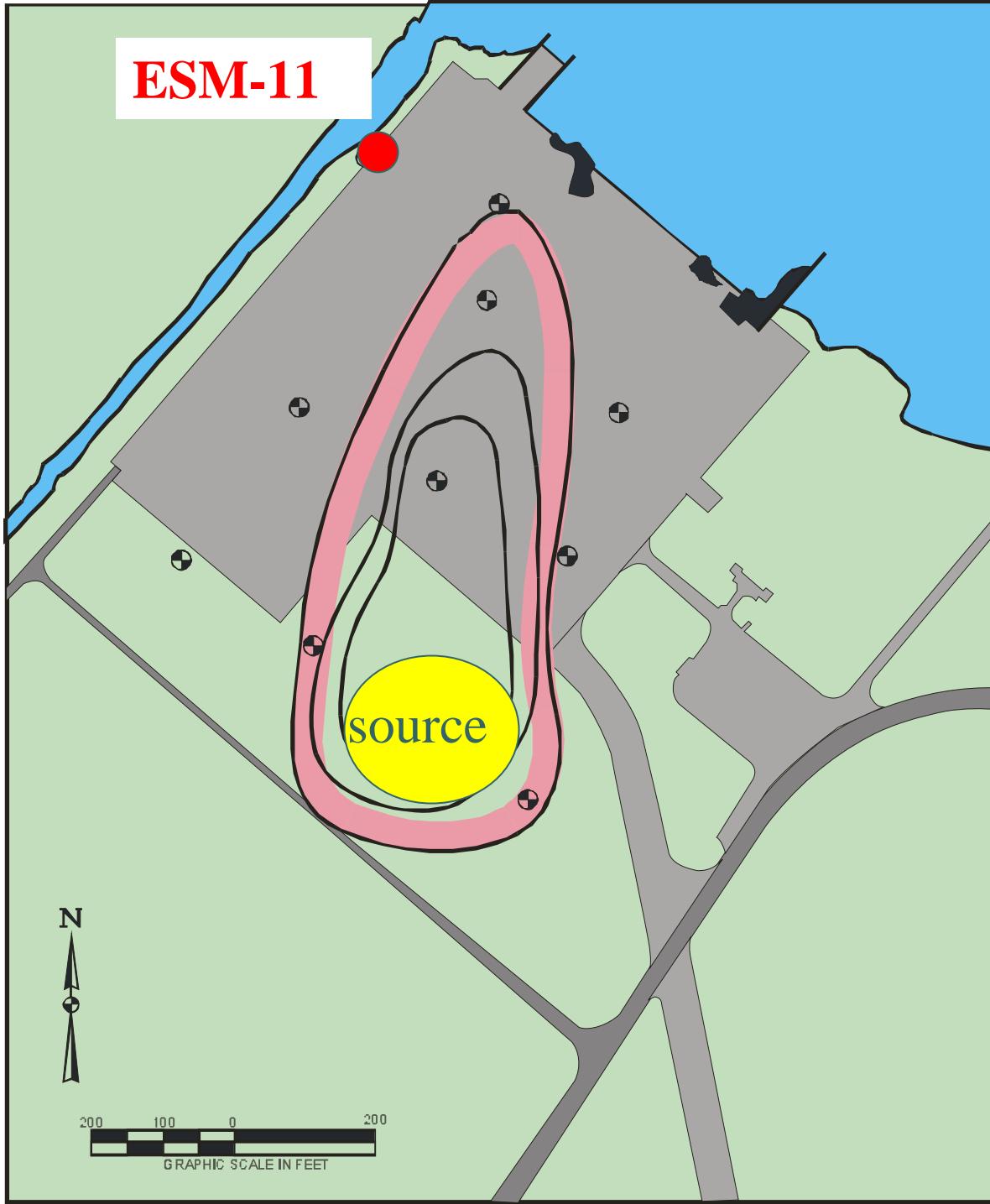
Virginia Dept. of Environmental Quality
EPA Region 3 LUST Technical Conference
Roanoke, Va
April 6, 2006



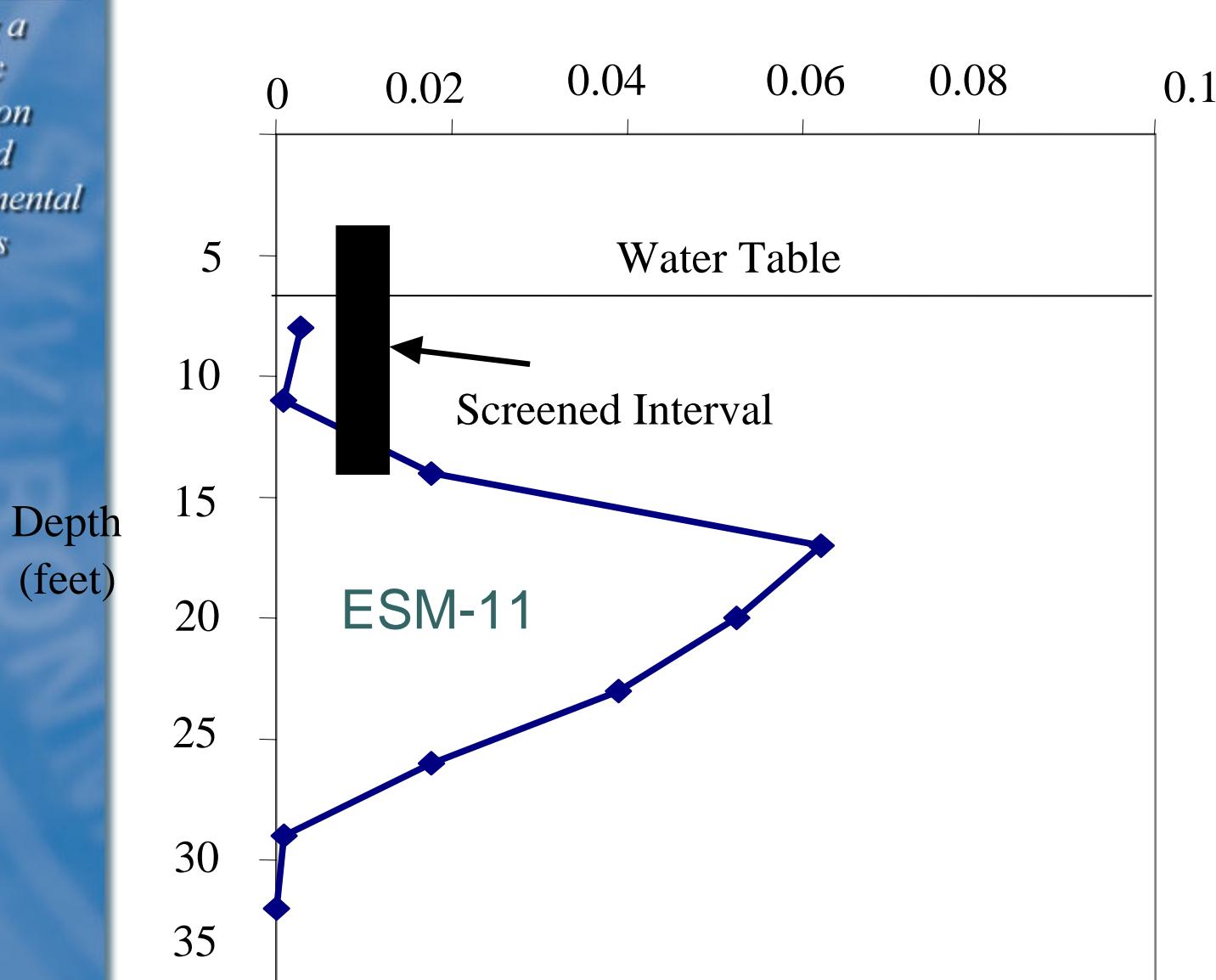


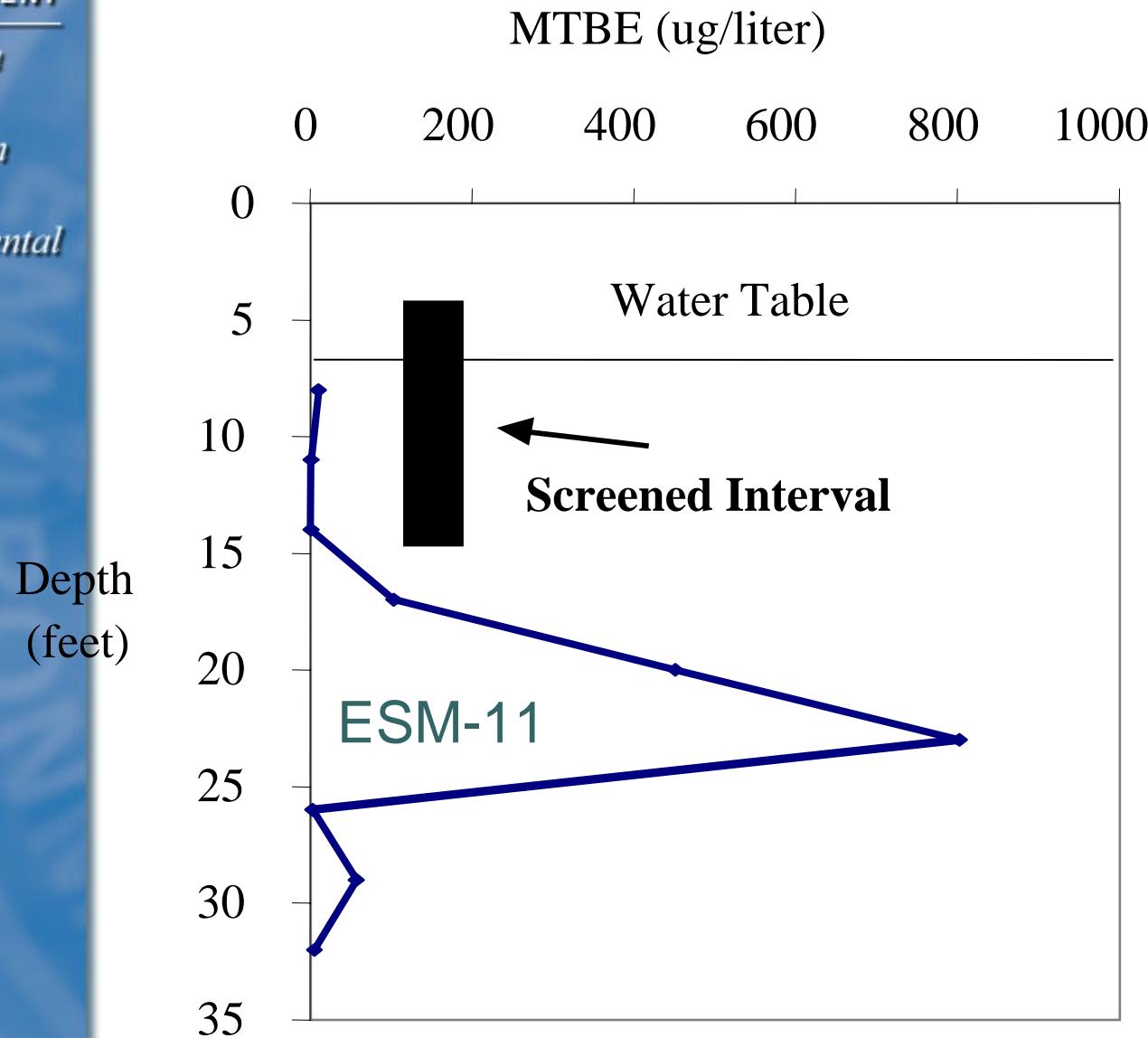
MTBE (ug/liter)

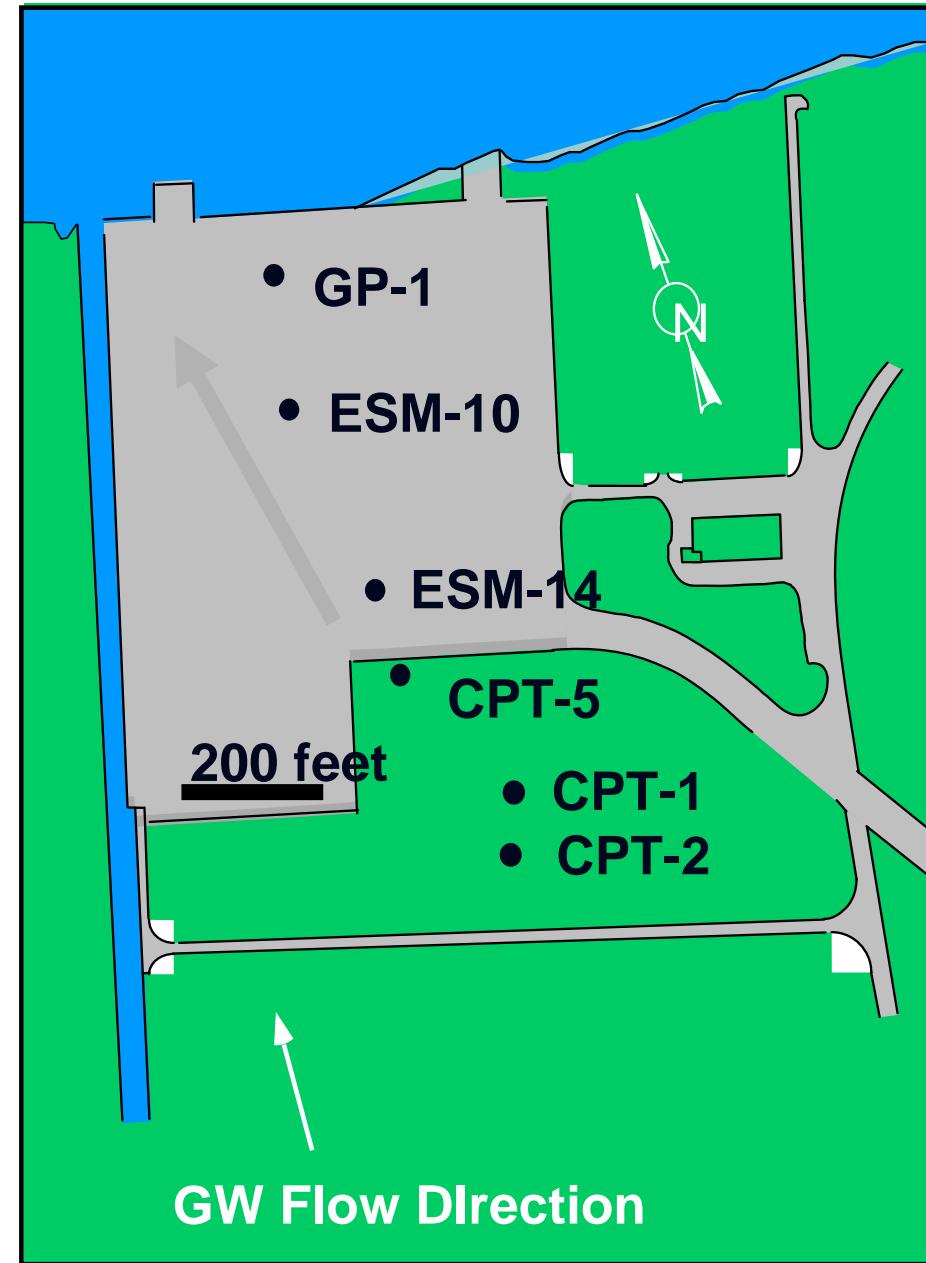




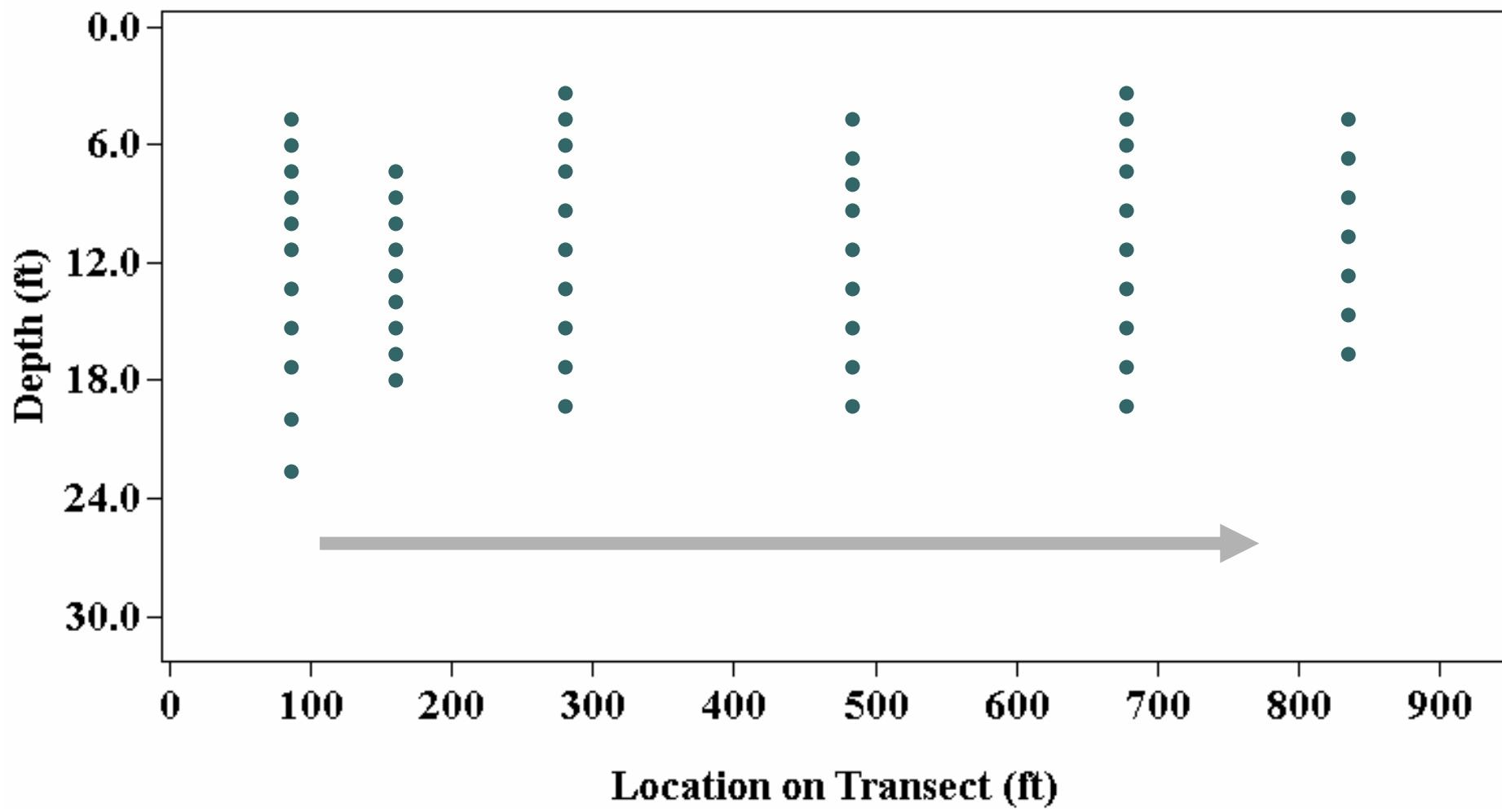
Hydraulic Conductivity (cm/sec)



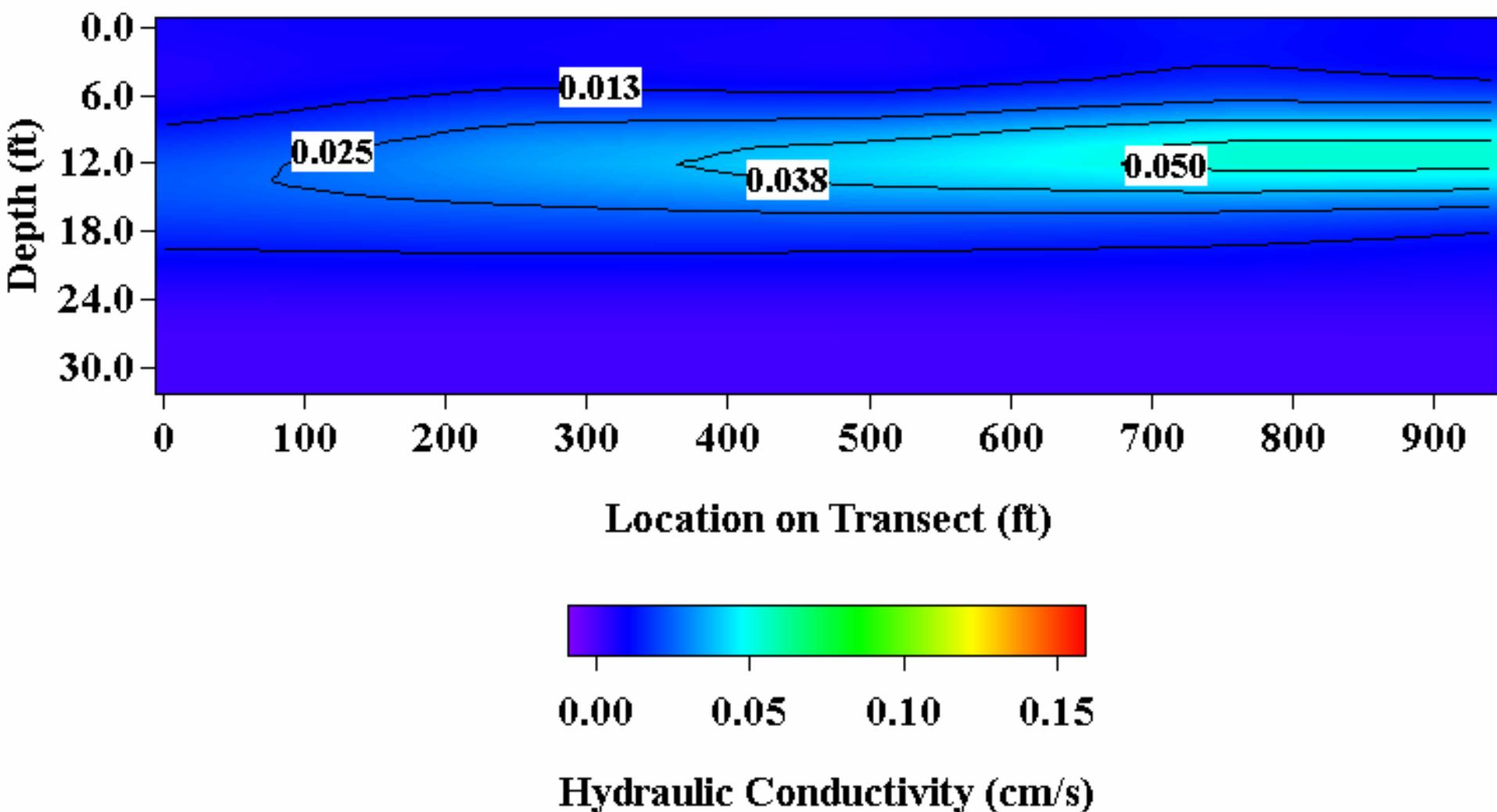




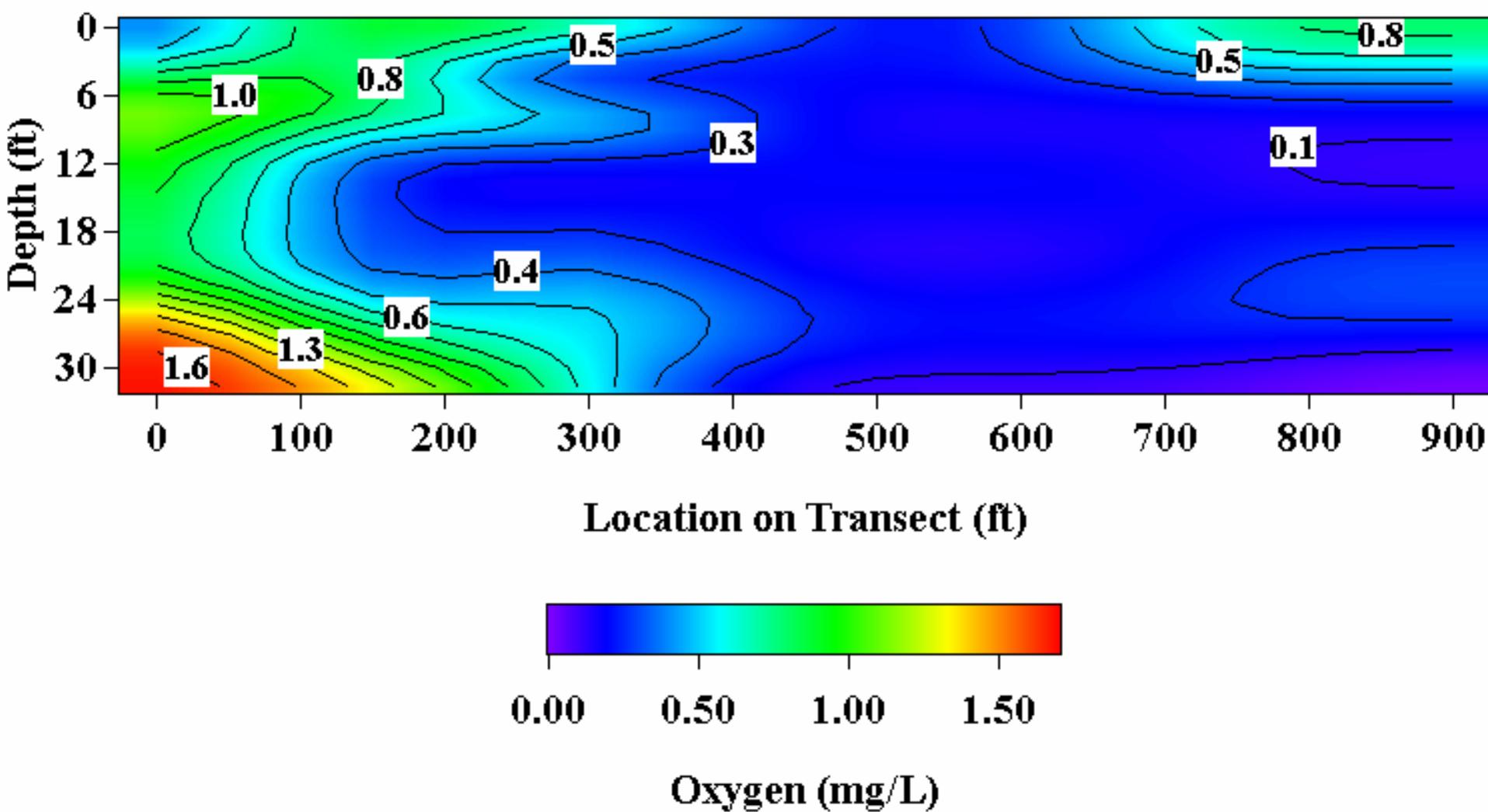
Location of Sampling Points



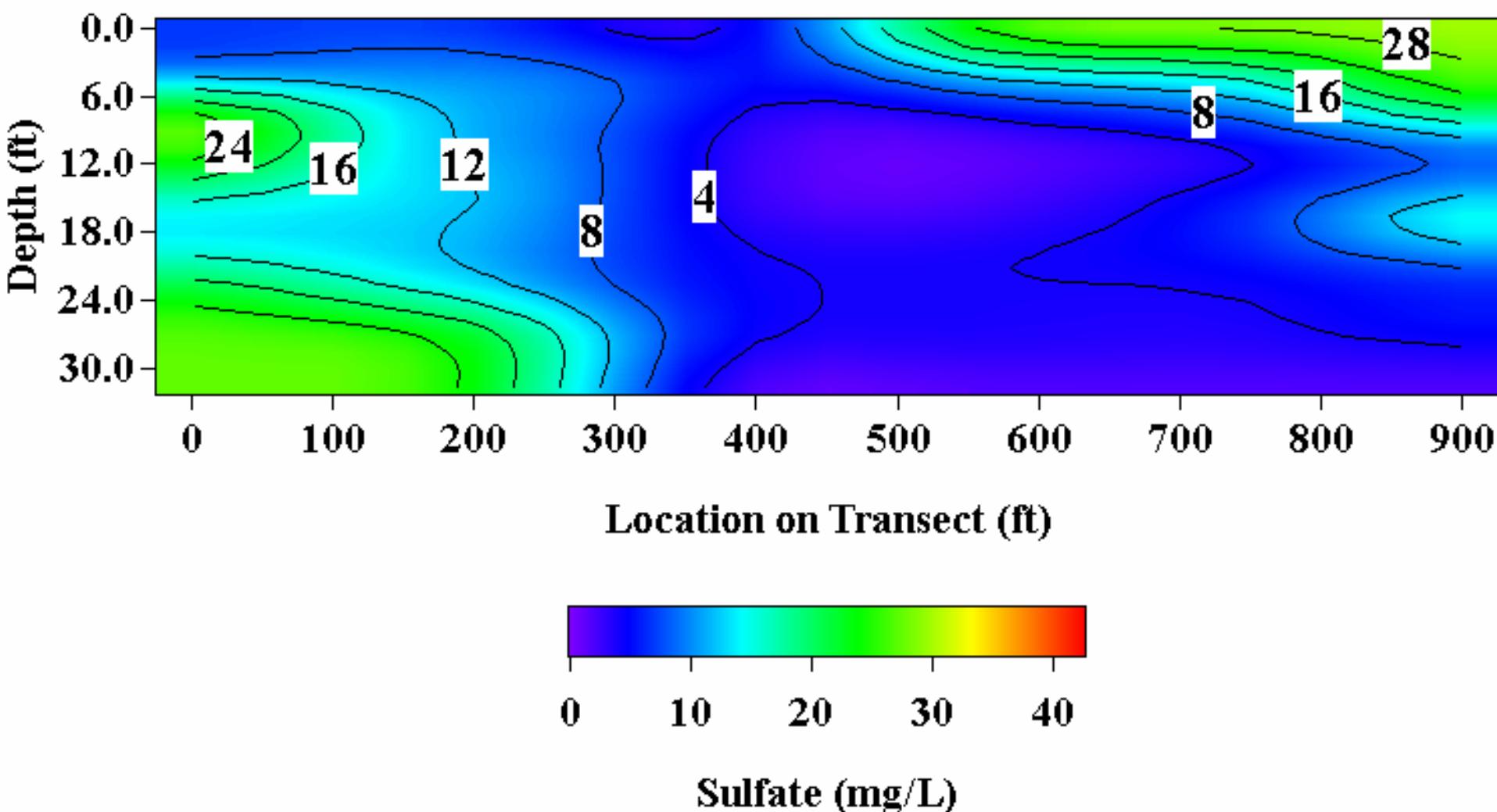
Spatial Distribution of Hydraulic Conductivity



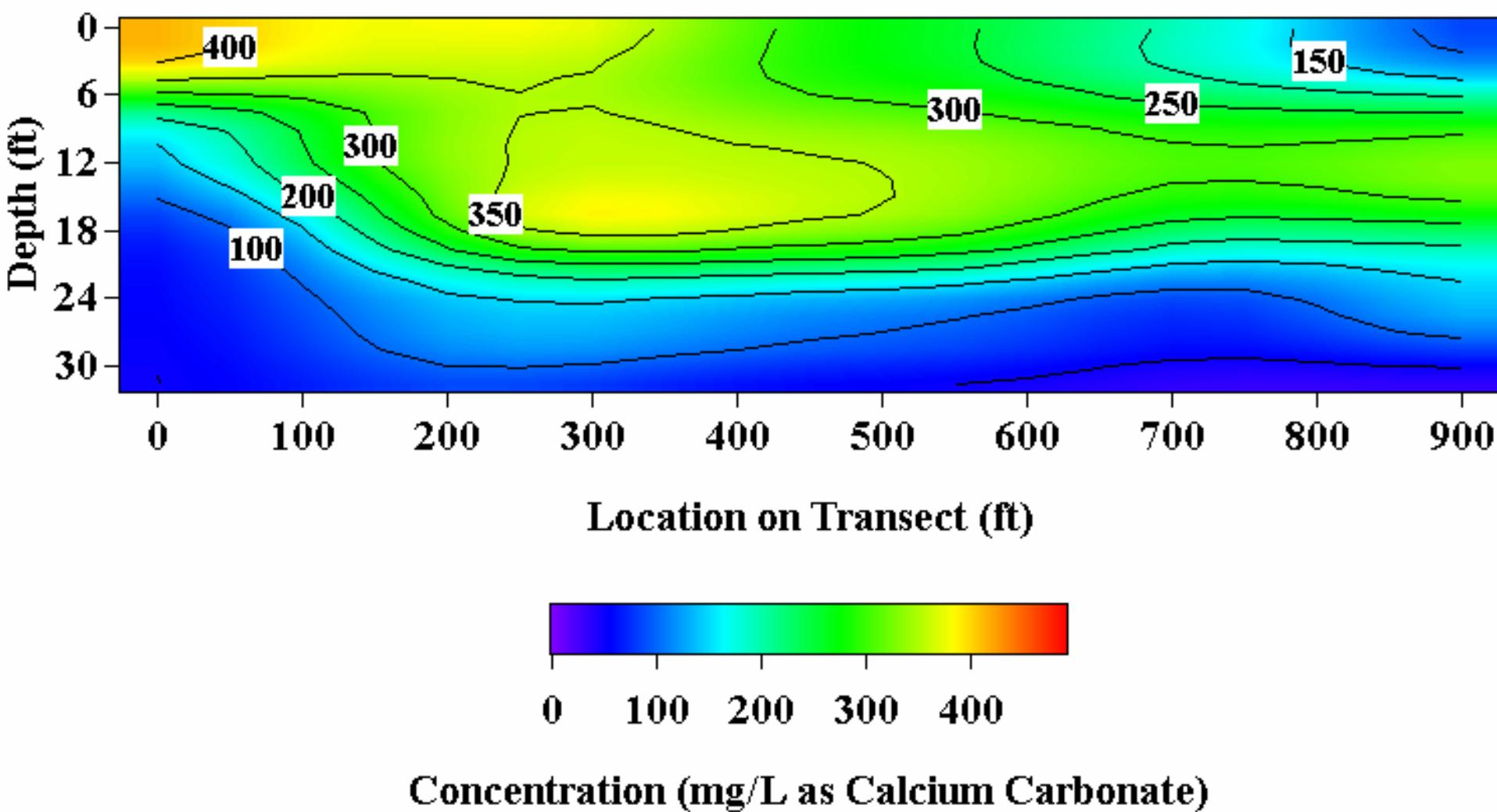
Spatial Distribution of Oxygen



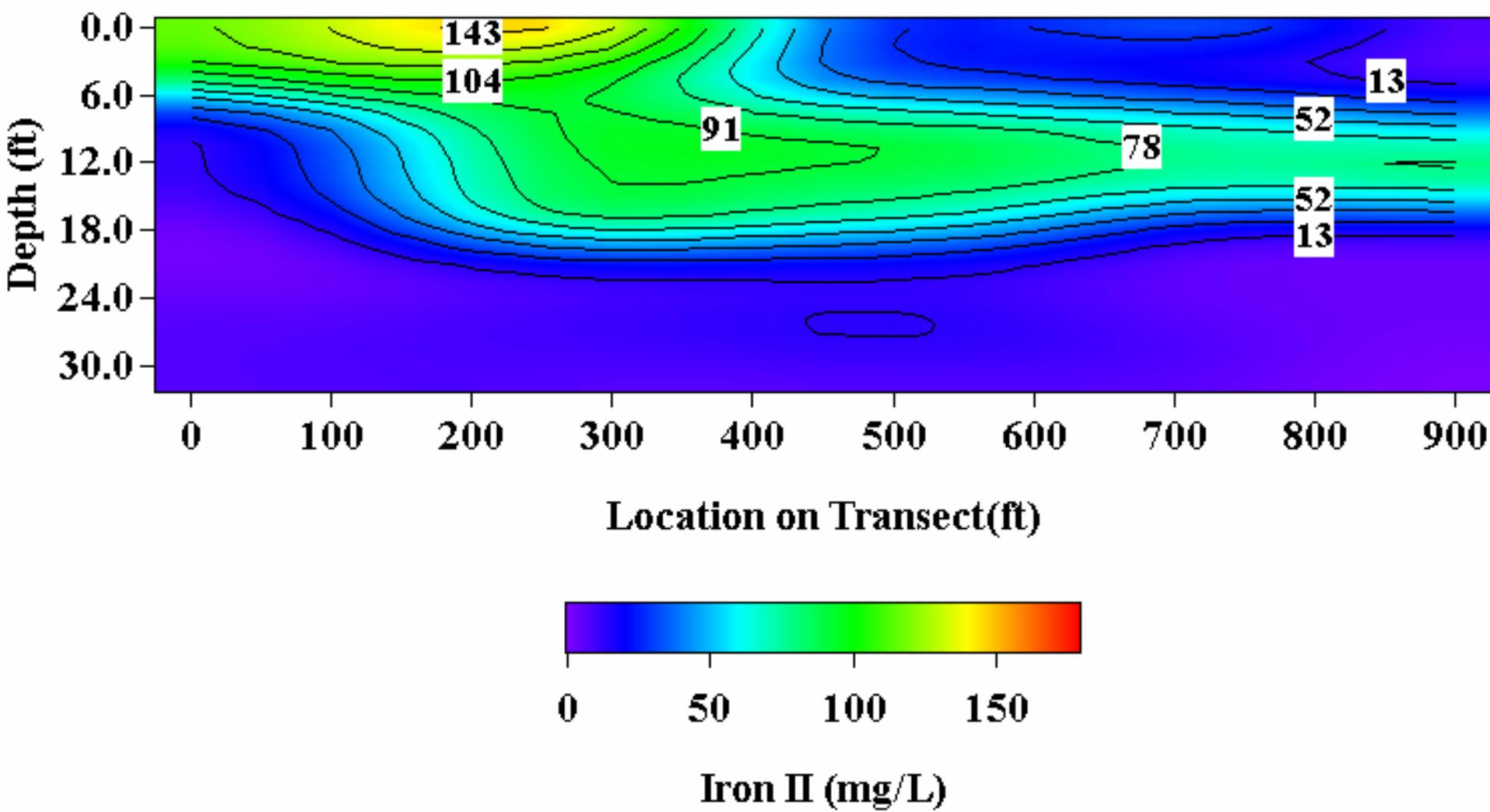
Spatial Distribution of Sulfate



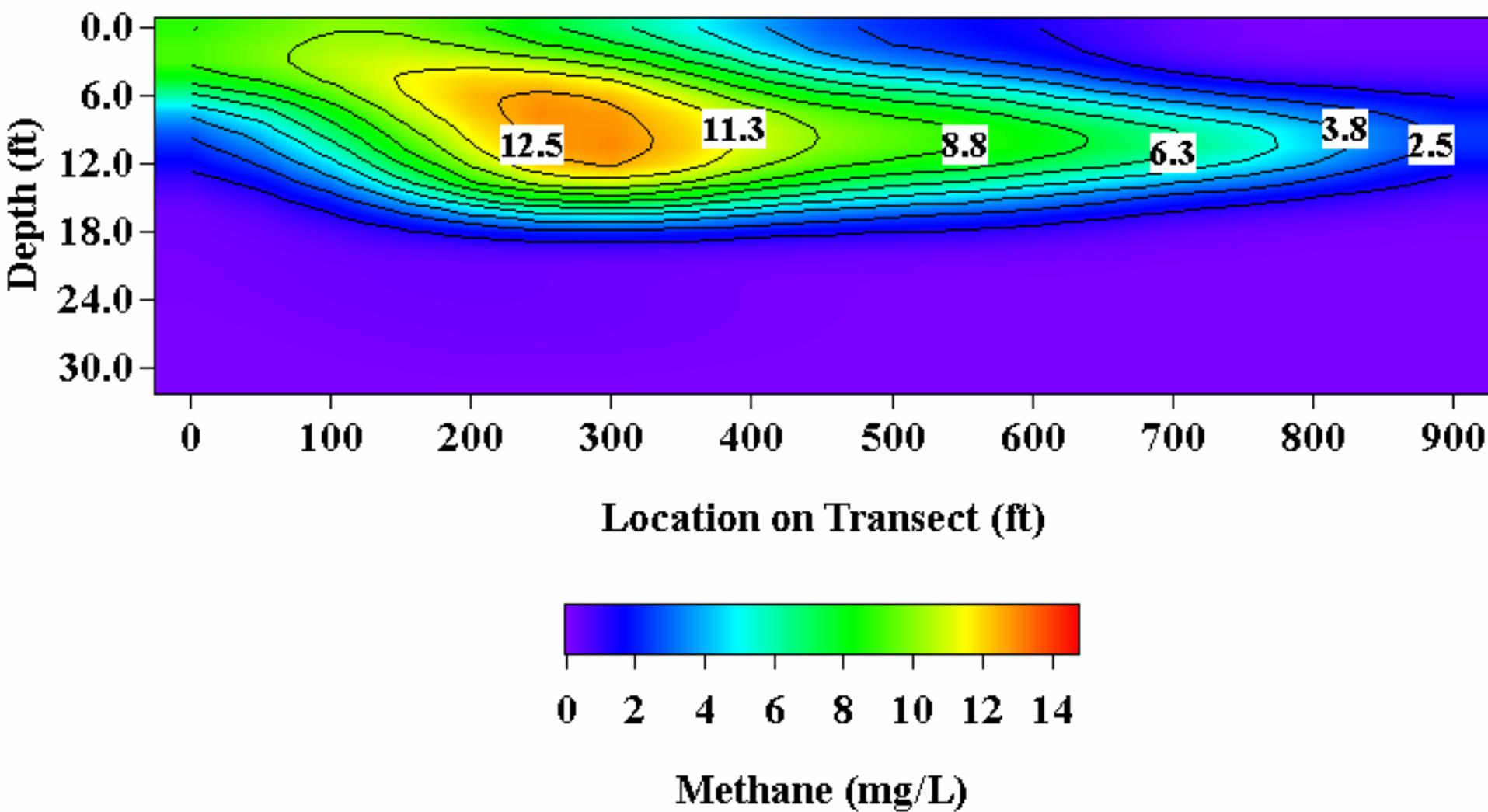
Spatial Distribution of Alkalinity



Spatial Distribution of Iron (II)



Spatial Distribution of Methane



Field Sampling

- Raymark Superfund Site, Stratford, CT
- Sampled 6 monitoring wells
 - Screened over water table
 - 2-in diameter, PVC
 - Size 10 slot

Water Sampling Devices Compared

- Peristaltic Pump (GeoTech®)
 - Submersible Pump (Grundfos ®)
 - Packer with Grundfos Pump ® (in two wells)
 - Bladder Pump (QED®)
-
- Low-Flow Purging and Sampling Methods (Puls and Barcelona, 1996)

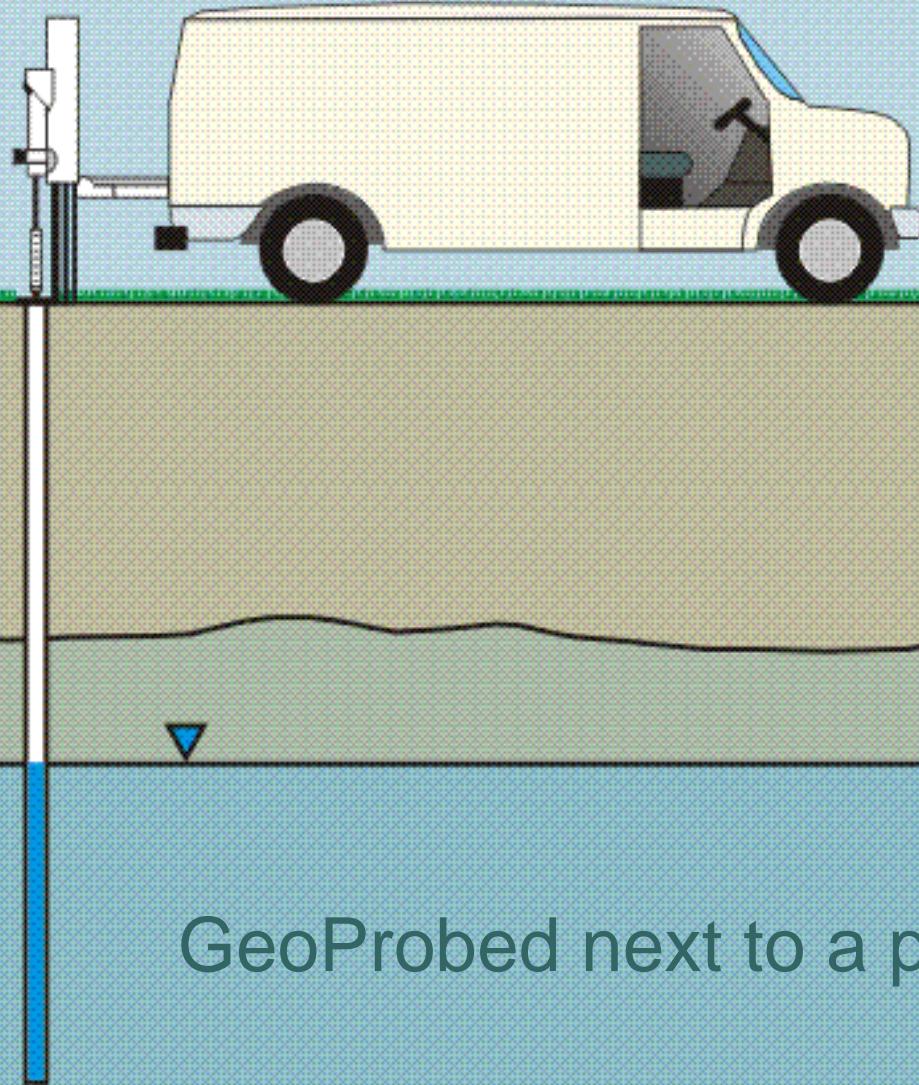
Monitoring Well Information

Well ID	Depth (ft)	Screen Length (ft)	Depth to Water (ft)
MW214S	27	15	17.8
MW215S	20	10	17.2
MW302S	24	10	19.4
MW523S	20	10	12.7
MW525S	23	10	19.1
MW526S	20	10	11.0

Vertical Profiling Devices Compared

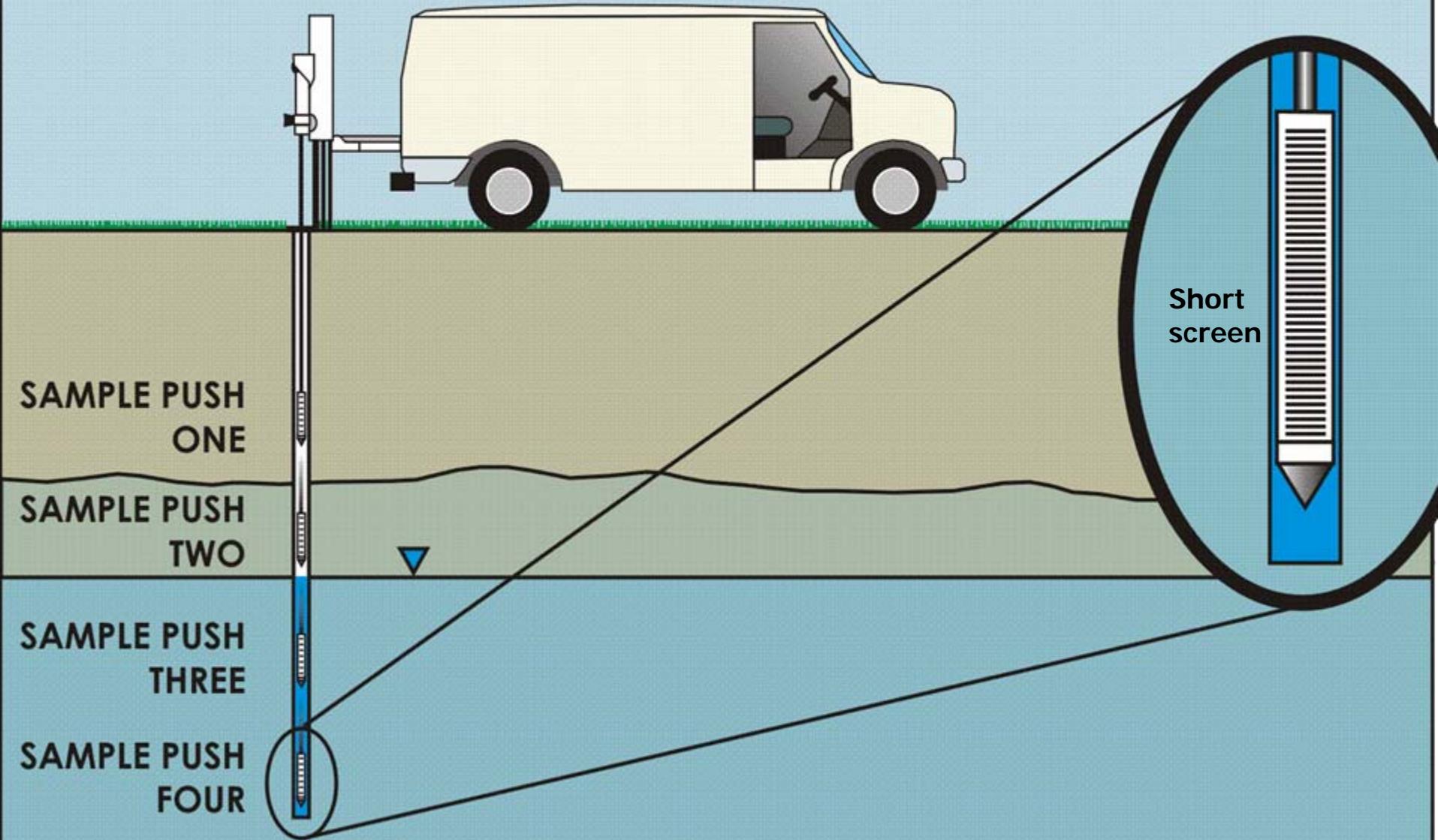
- Within Monitoring Well
 - Passive Diffusion Bags (PDBs)
 - DMLS®
- Adjacent to Monitoring Well
 - Geoprobe®
(presumably undisturbed geologic zone)

GEOPROBE®



GeoProbed next to a permanent well.

GEOPROBE[®]



Passive Diffusion Bags

(from ITRC Draft Guidance Document)



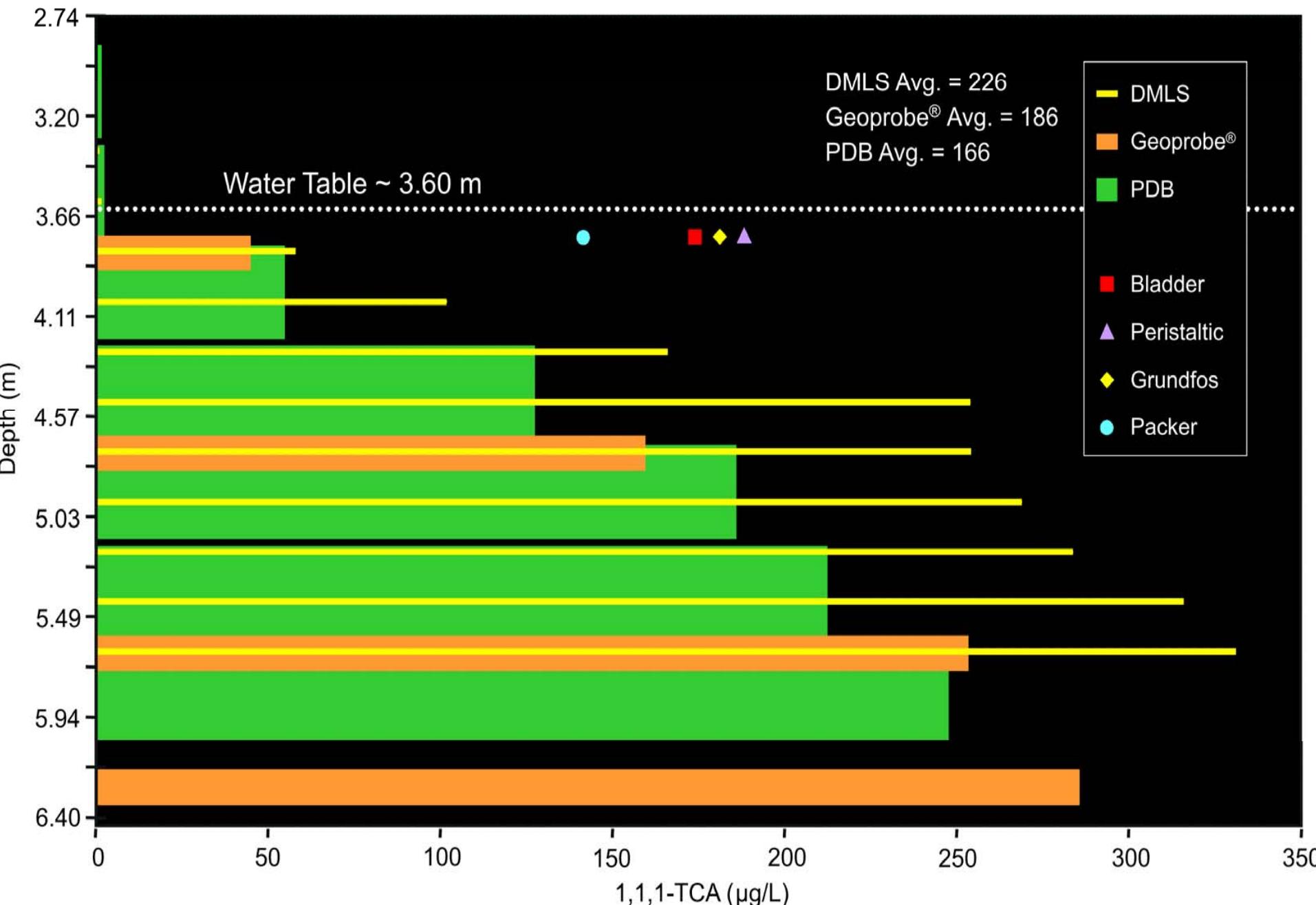
Discrete Multi-Level Sampling (DMLS) System



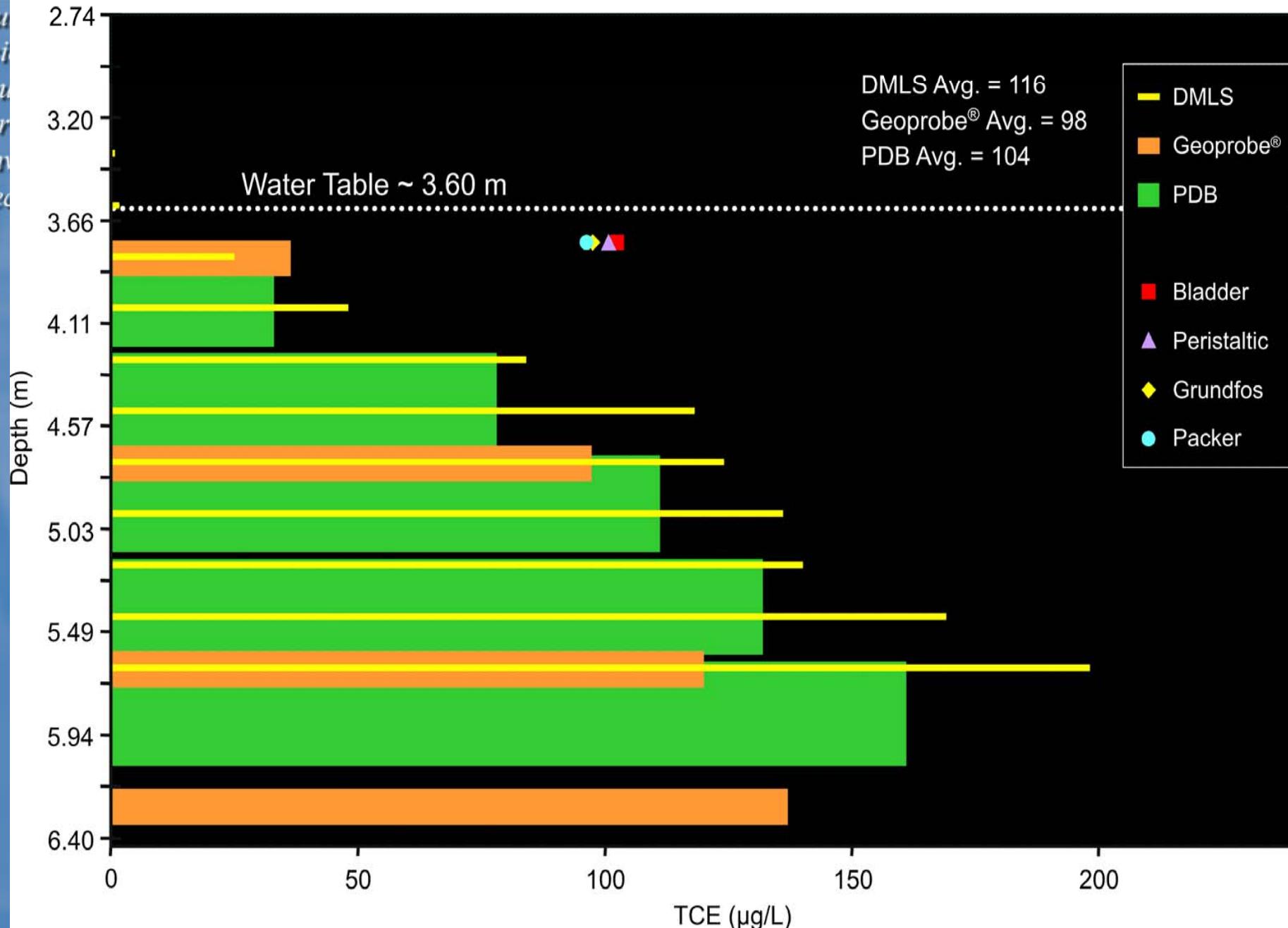
Correlation between the concentrations in ground water and the water sampling device used

Used chlorinated VOAs for
case study to avoid
complications from aerobic
biodegradation.

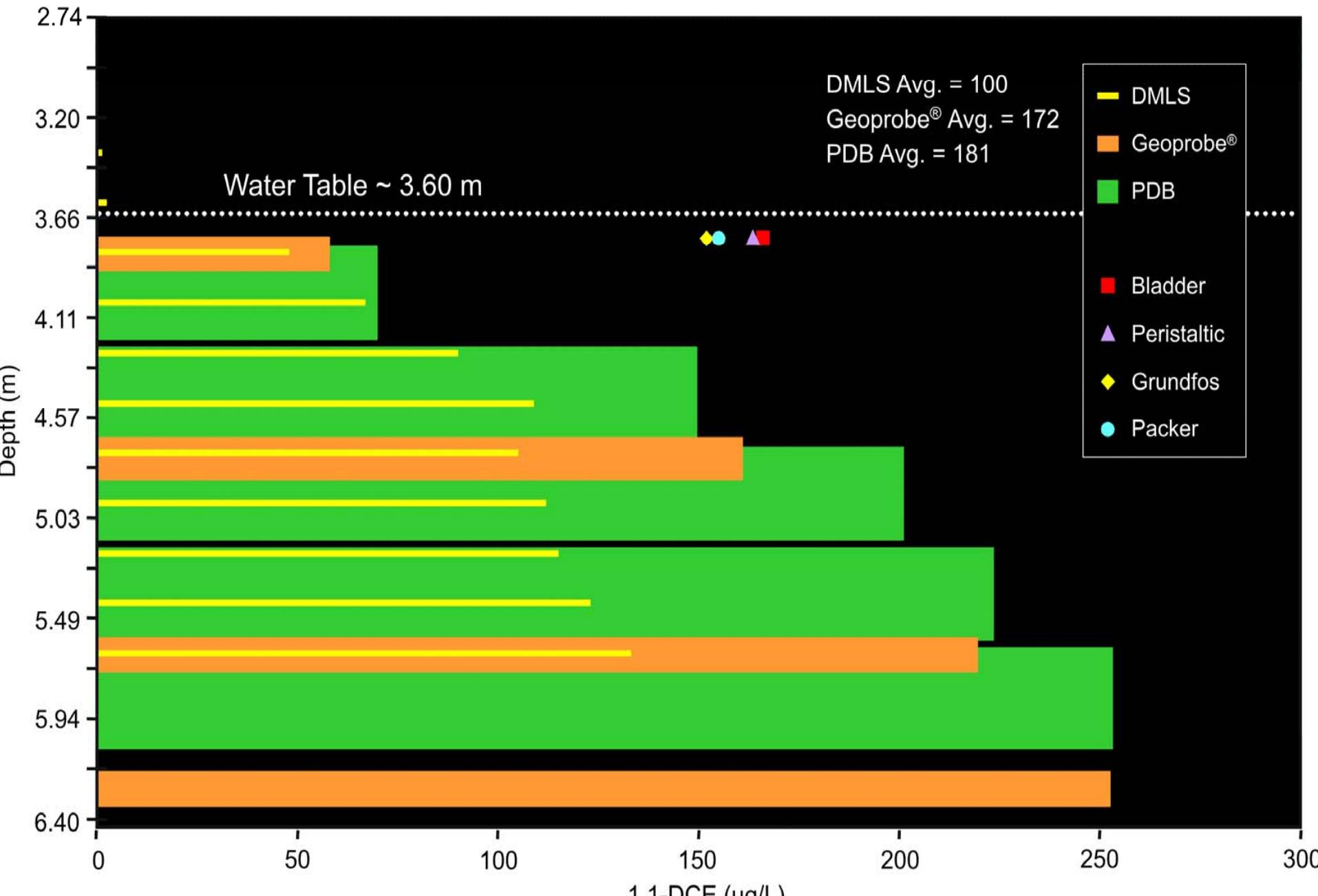
MW526S 1,1,1-TCA



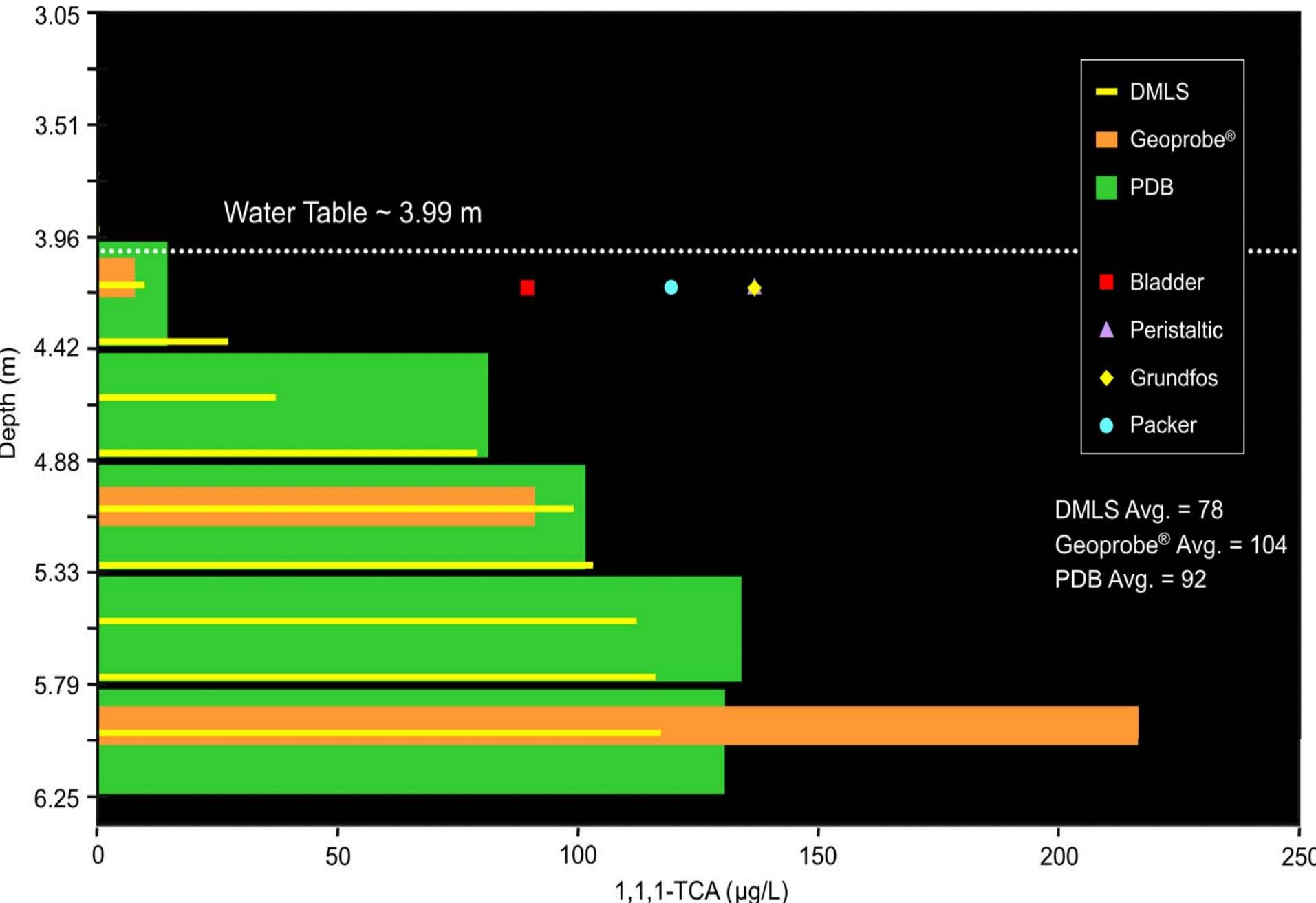
MW526S TCE



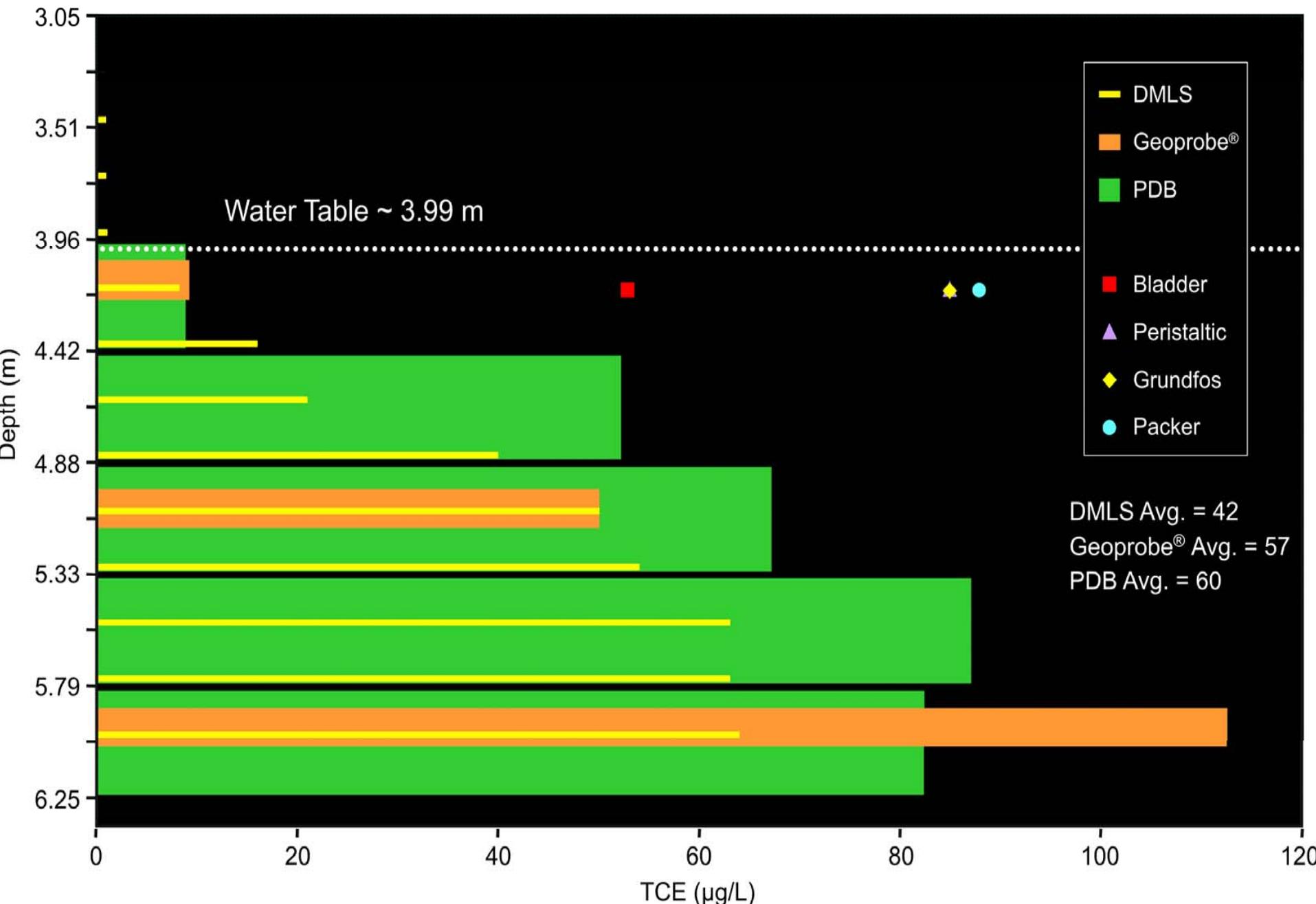
MW526S 1,1-DCE



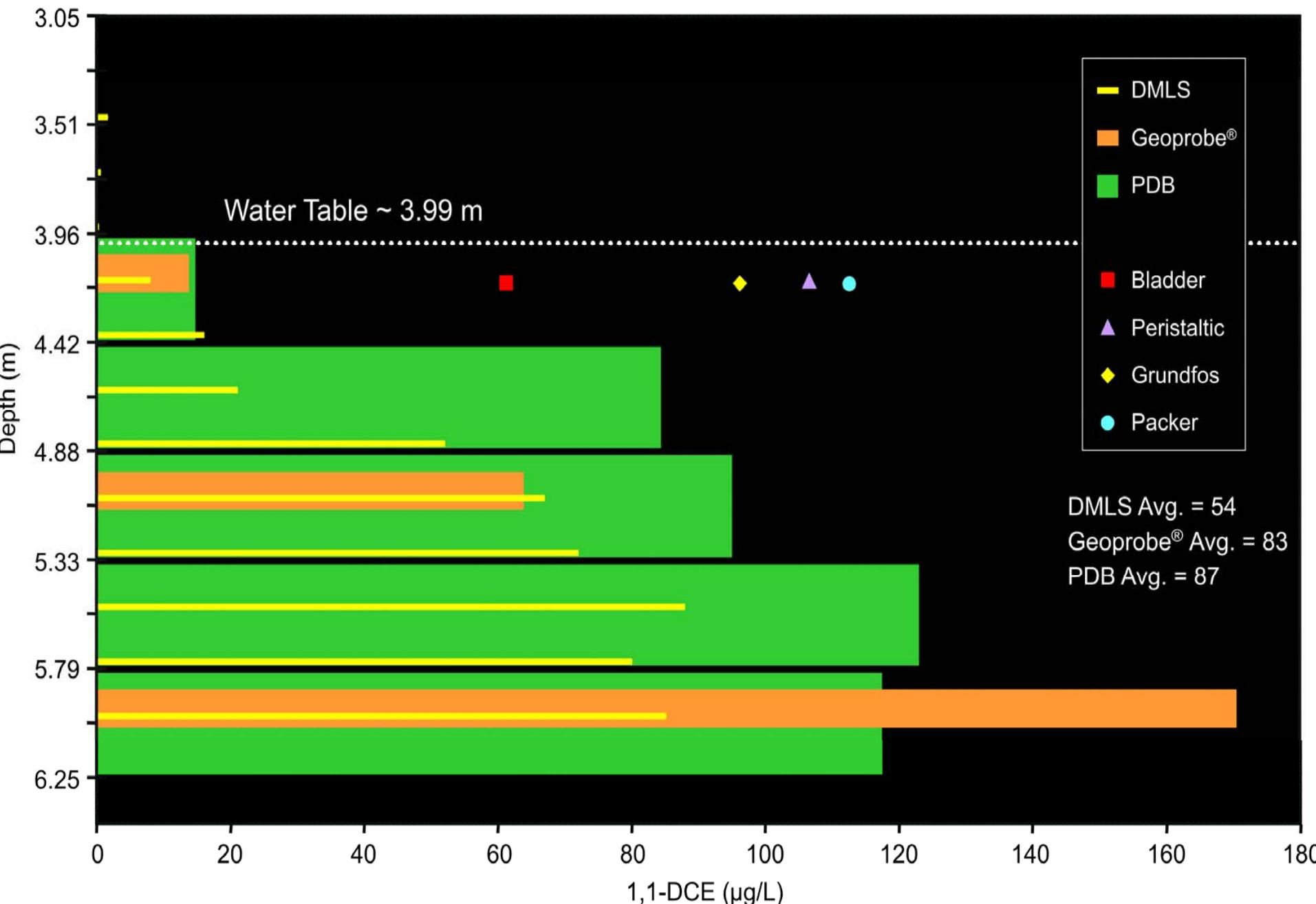
MW523S 1,1,1-TCA



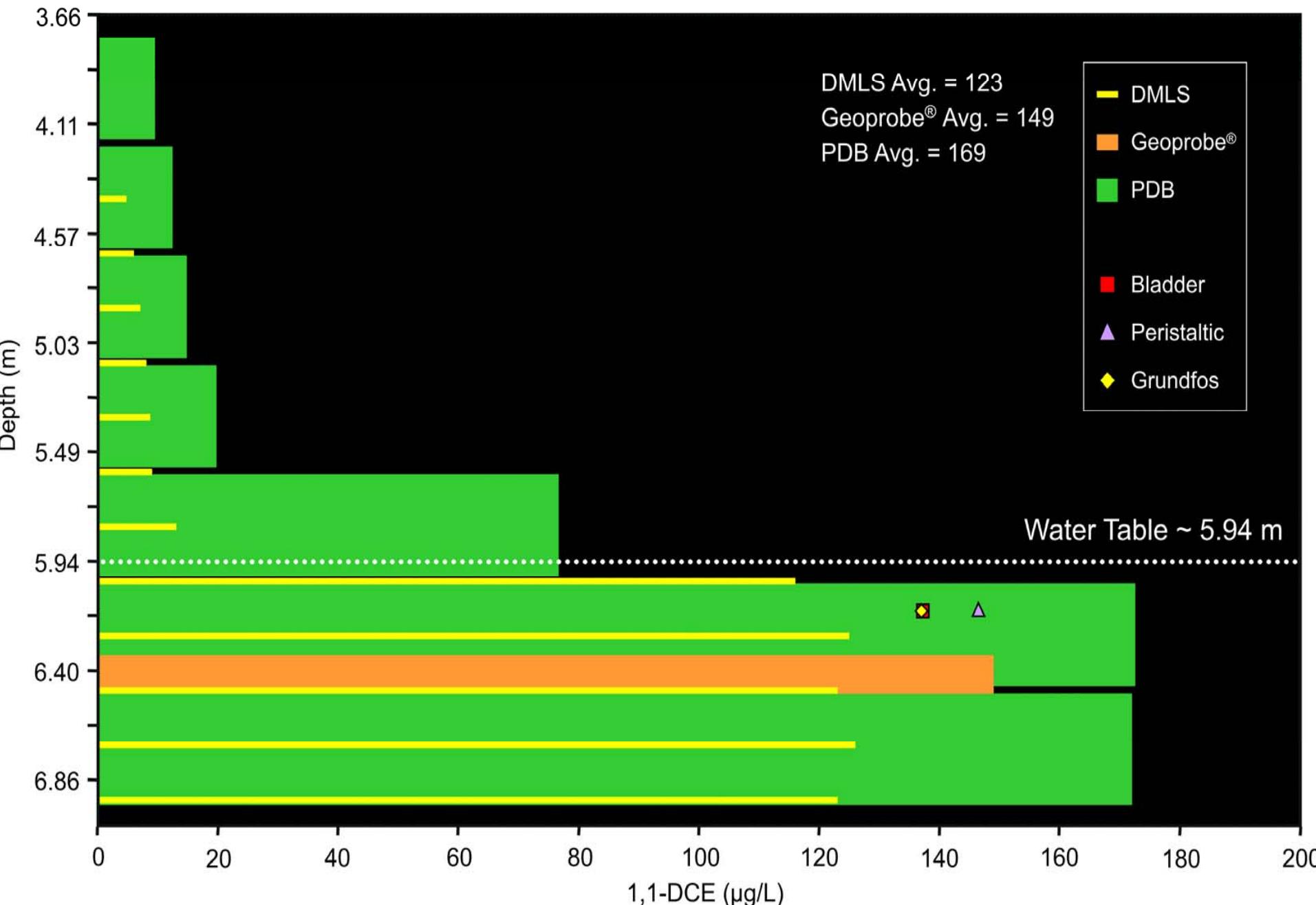
MW523S TCE



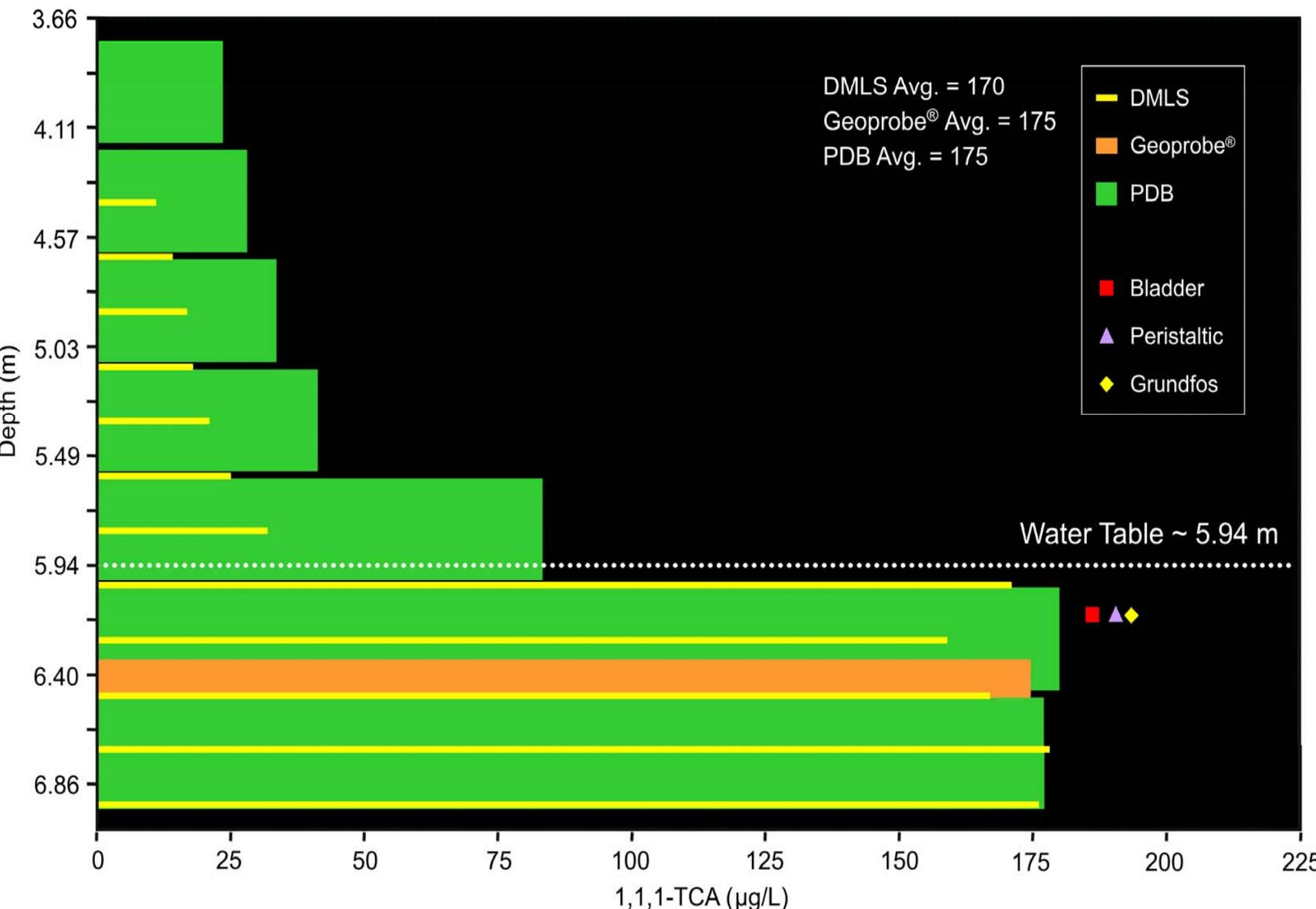
MW523S 1,1-DCE



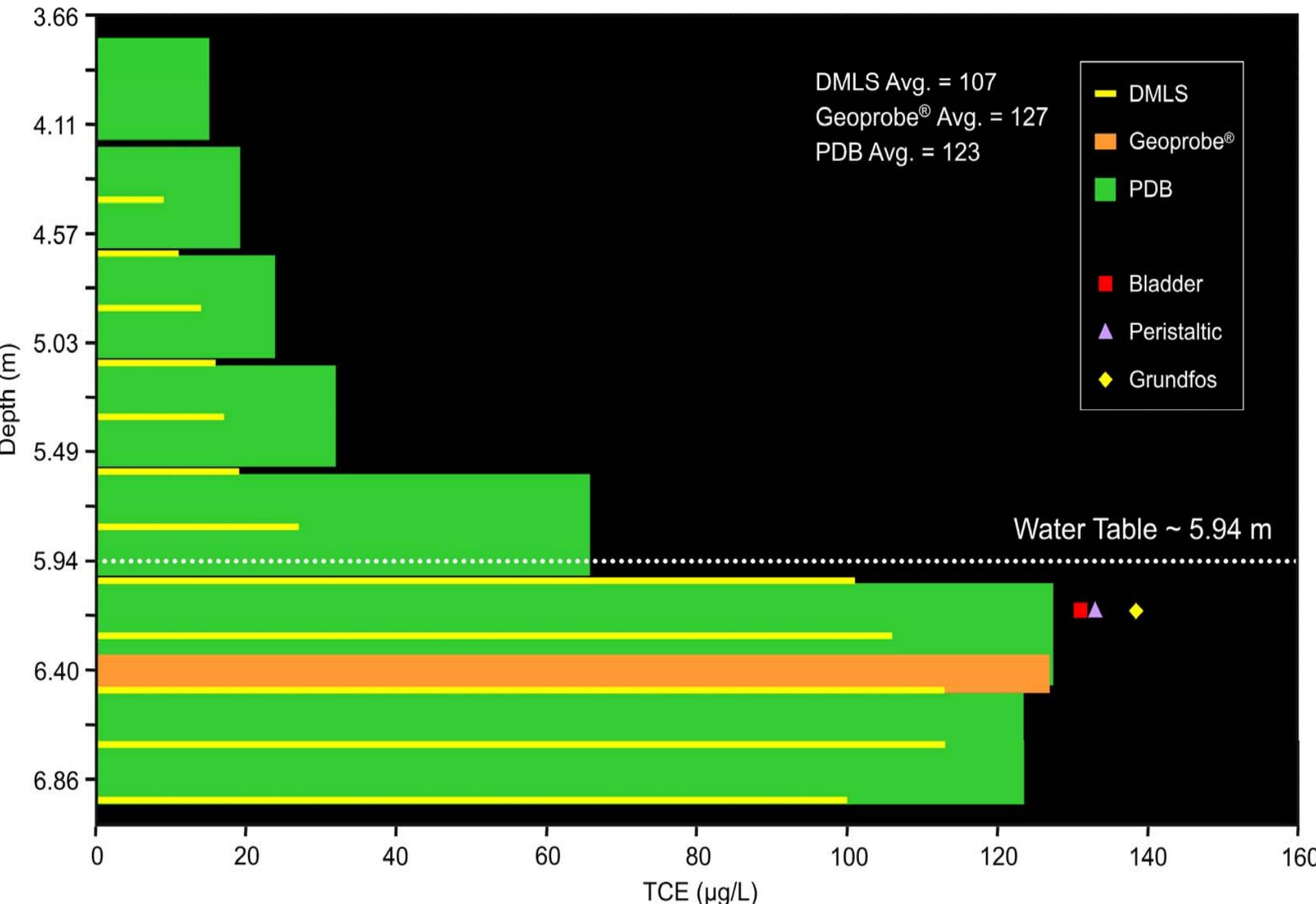
MW525S 1,1-DCE



MW525S 1,1,1-TCA



MW525S TCE

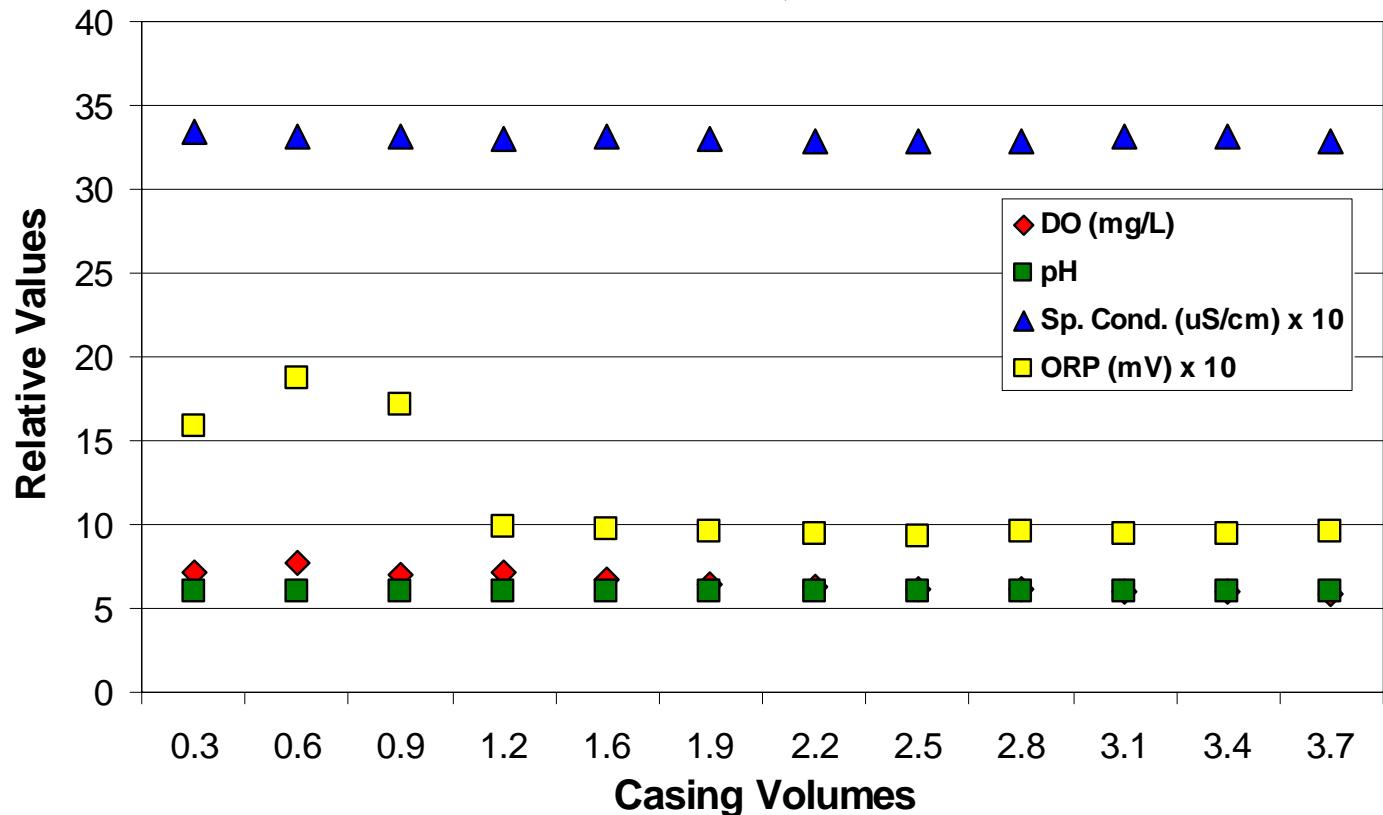


How many casing volumes should
be purged from a permanent
monitoring well?

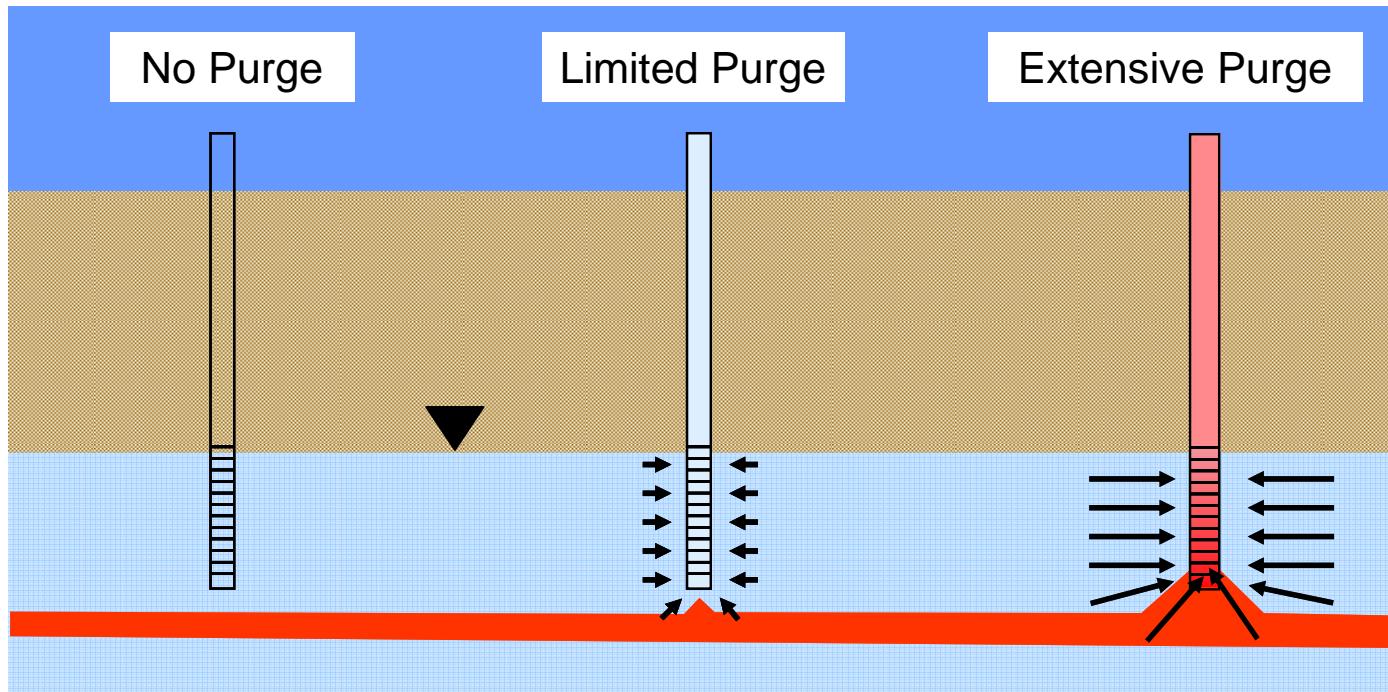
What is the best geochemical
parameter to monitor?

Grundfos Pump

MW302S Raymark WQPs

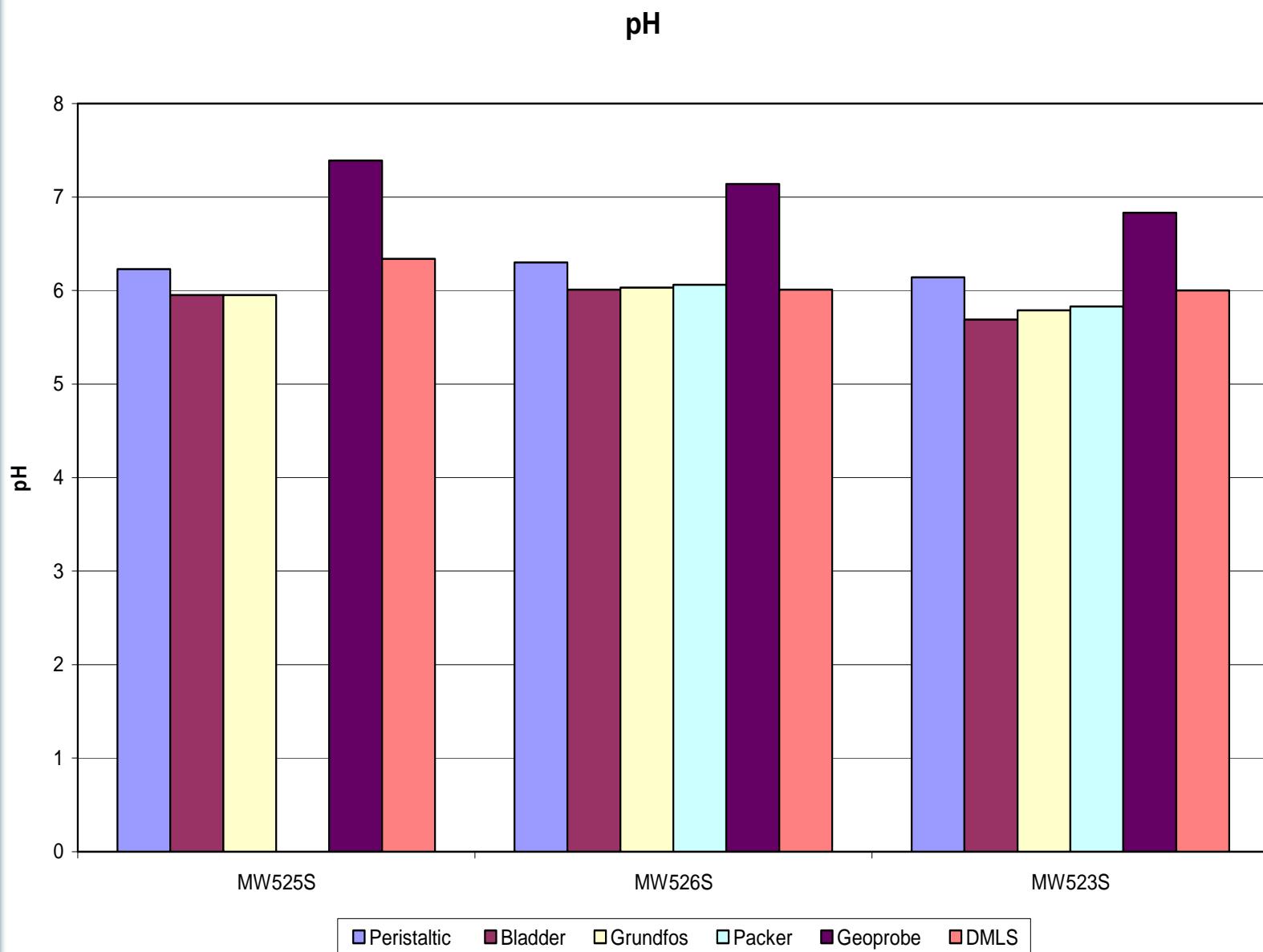


Stability was reached rapidly.

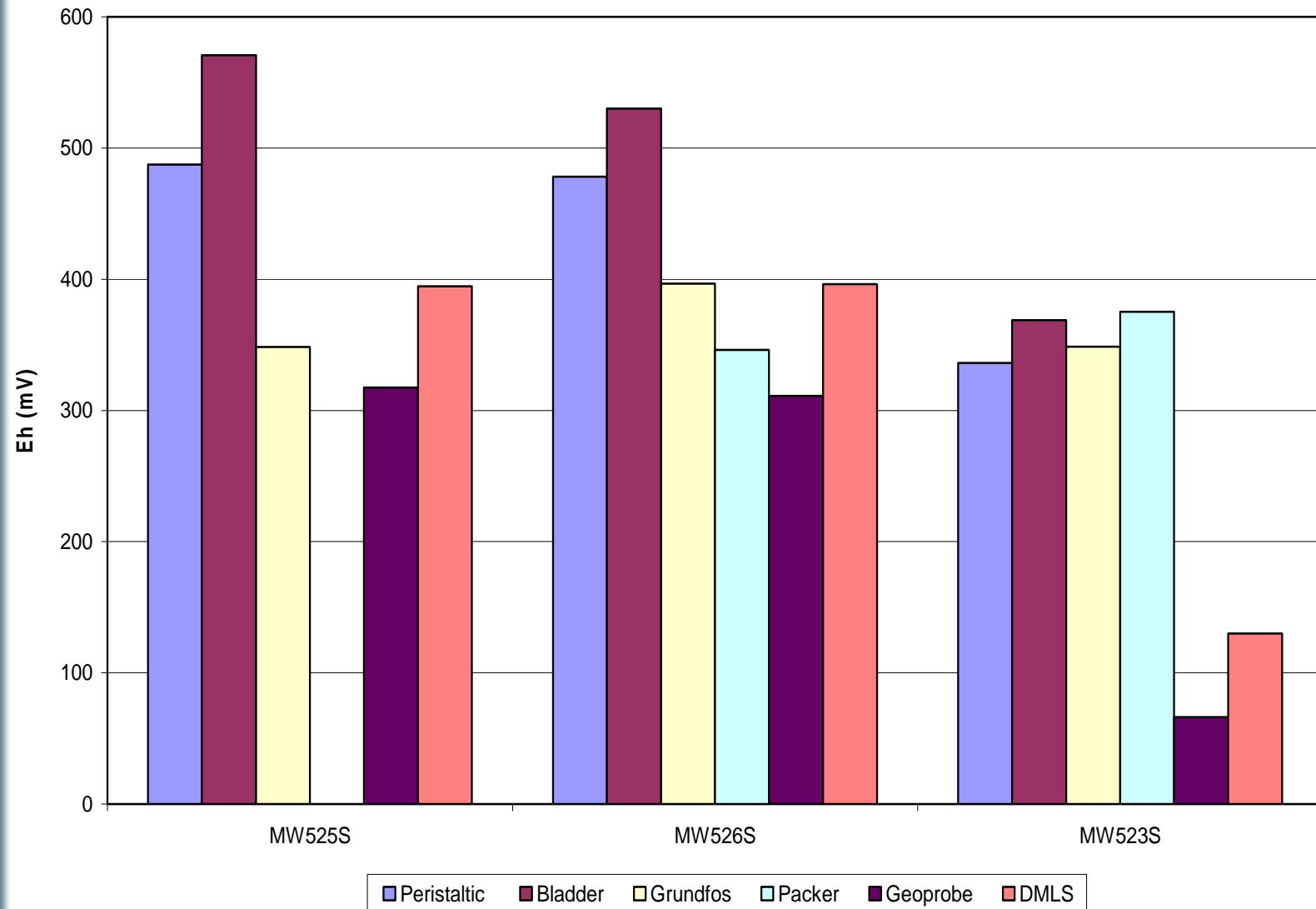


The casing volumes required to reach “stability” is a reflection of heterogeneity in the contaminant distribution and flow in the aquifer. It is not really a property of the well. Some wells never “stabilize.”

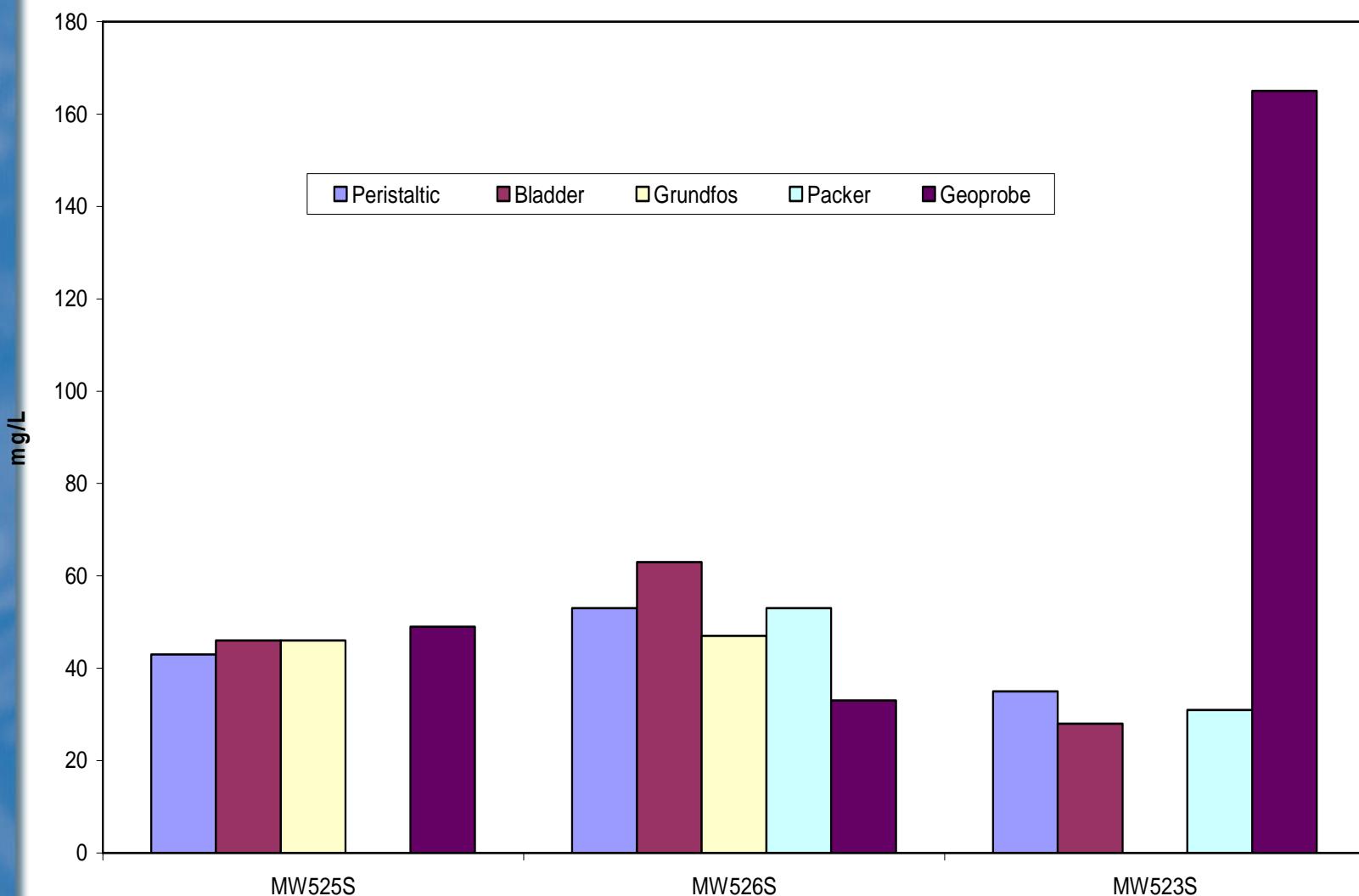
How do different sampling devices affect values for geochemical parameters?



Eh

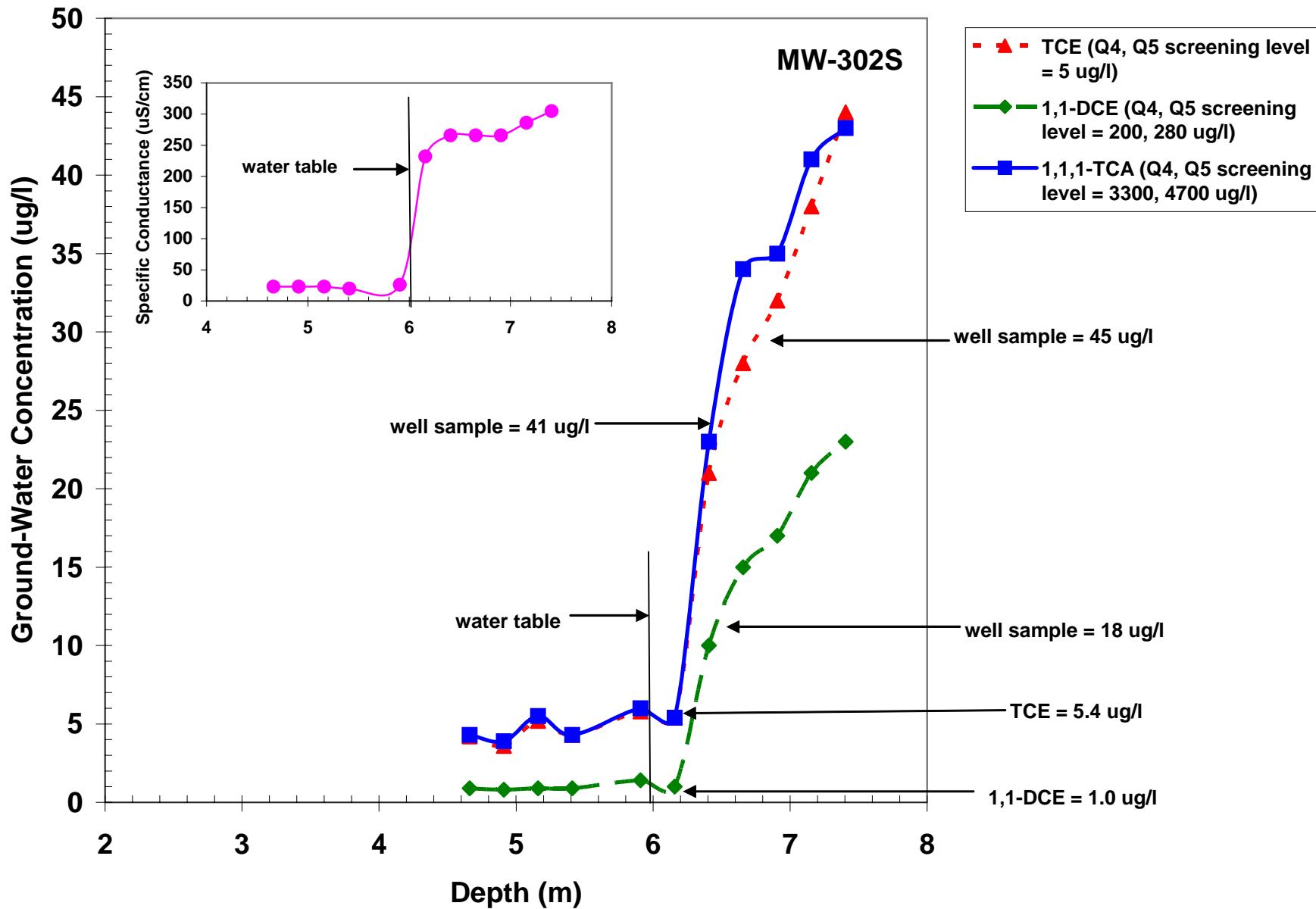


Alkalinity

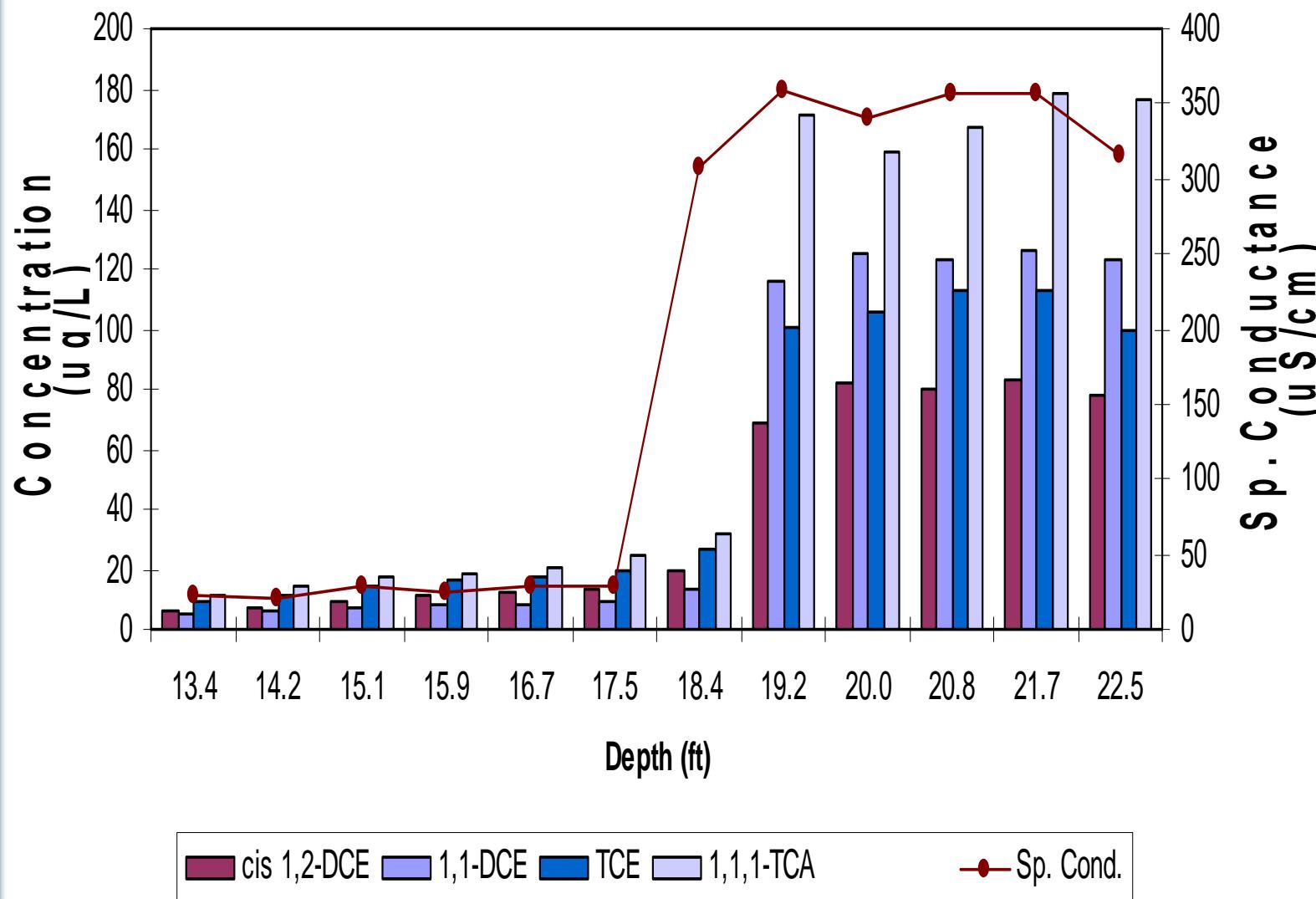


What about monitoring to
calibrate models for vapor
intrusion?

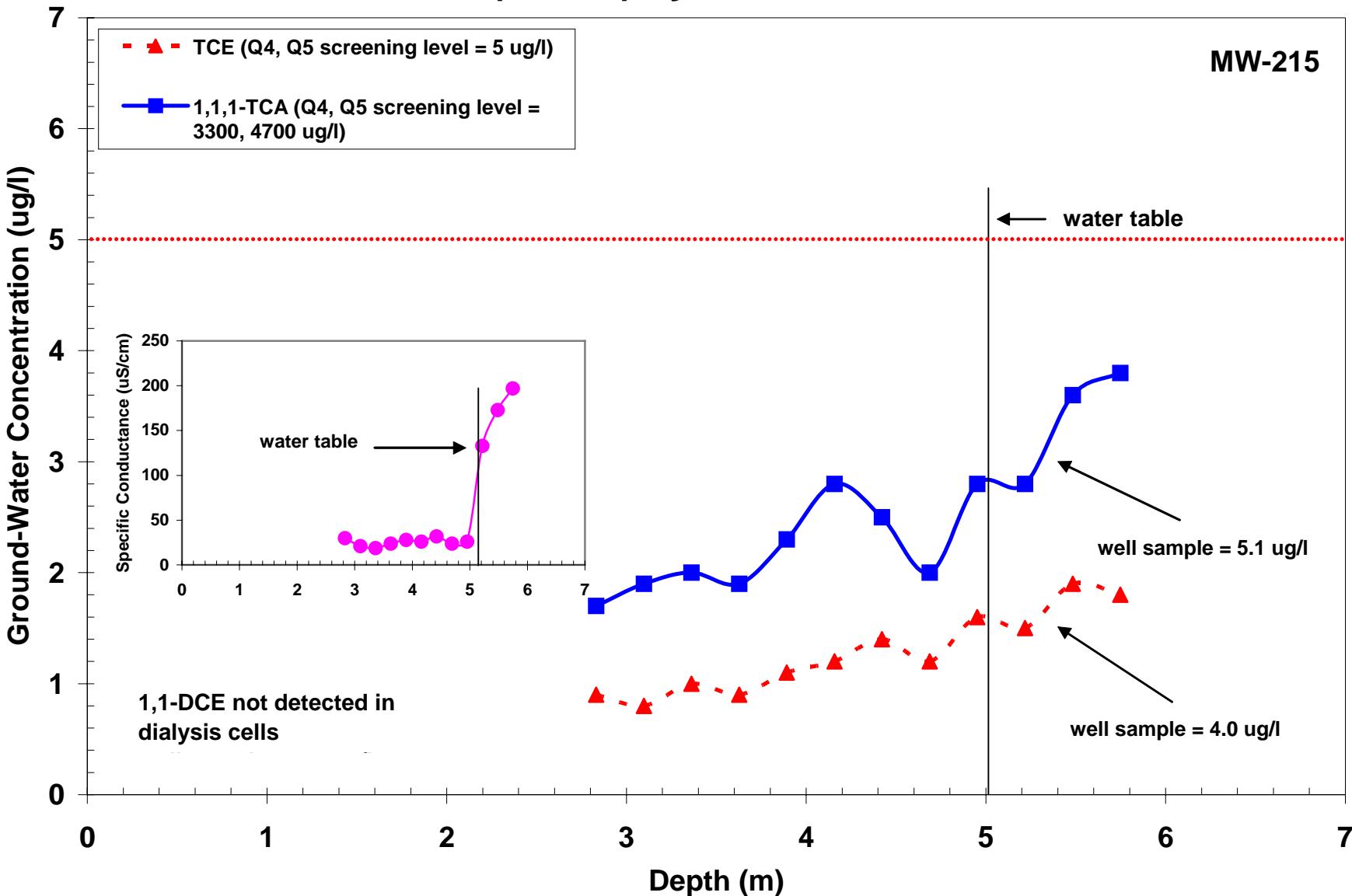
Ground-Water Profile at MW-302S Using Discrete Multi-Level Sampling (DMLS) system



MW525S DMLS



Ground-Water Profile from Closest Monitoring Well to House A (15 m) and House B (32 m) Using Discrete Multi-Level Sampling (DMLS) system

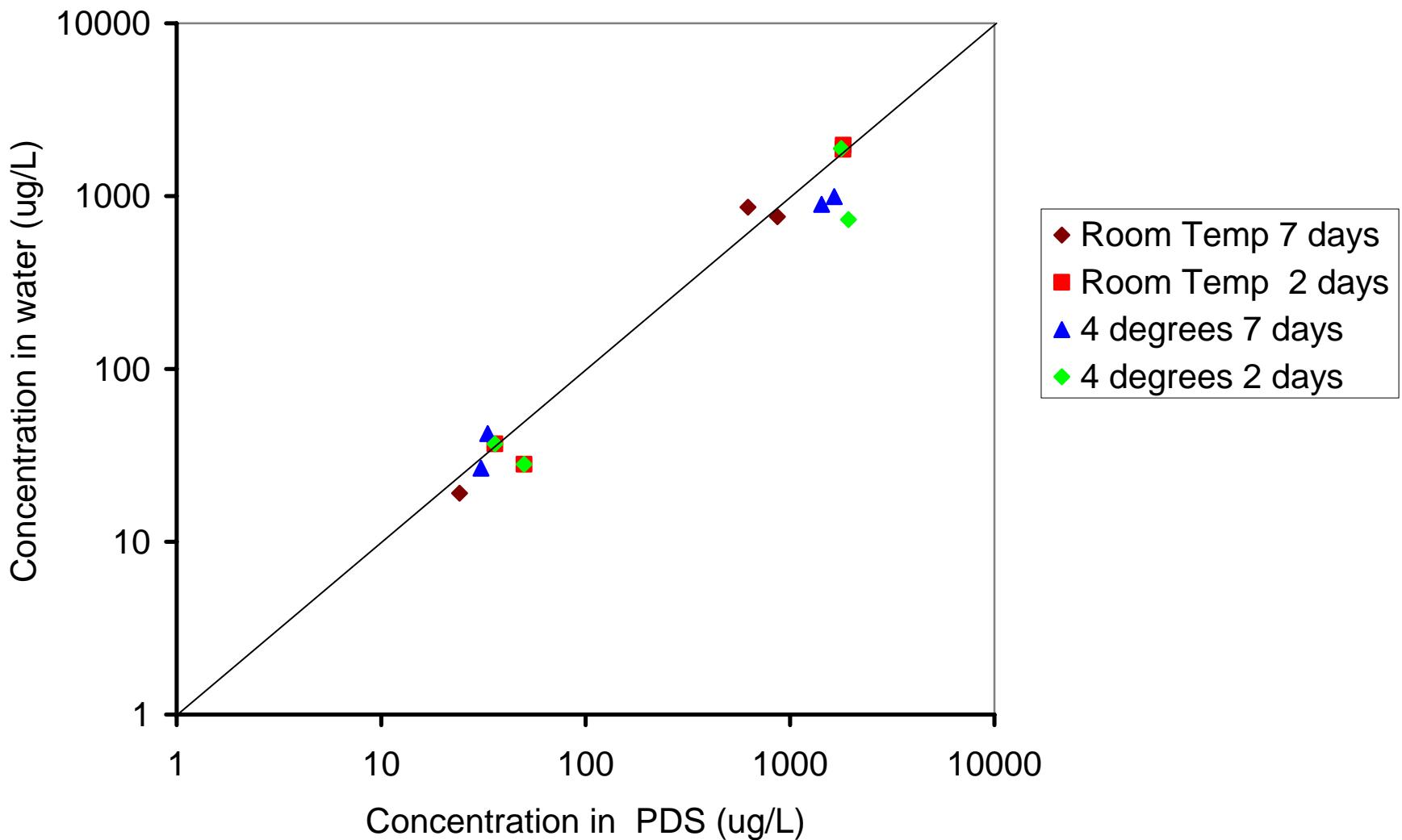


Next steps:

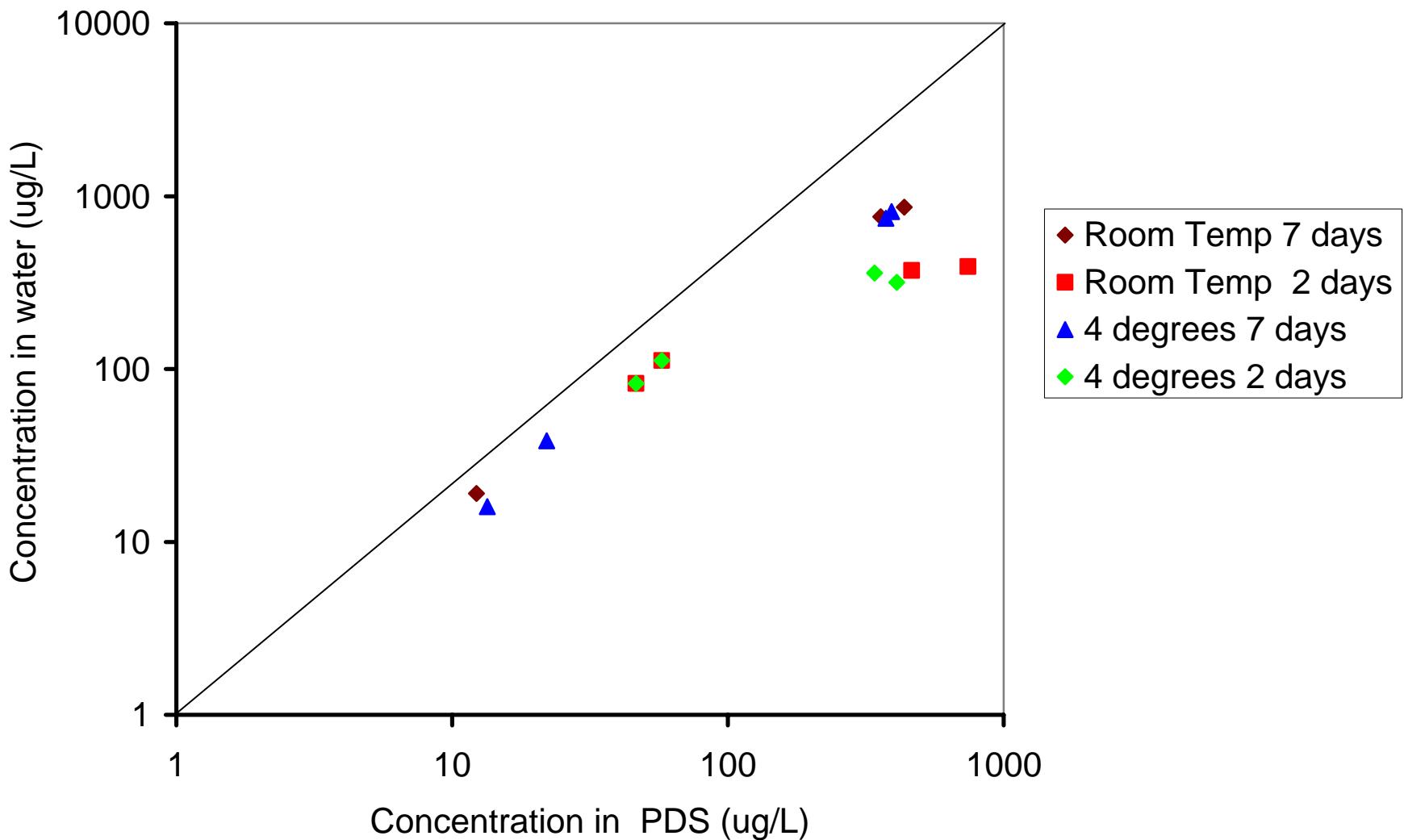
Calibrating passive diffusion samplers to allow monitoring of Benzene and MTBE profiles in vapors.

Looking for new study sites. If you have a good one, let's talk.

MTBE with Supor Membrane

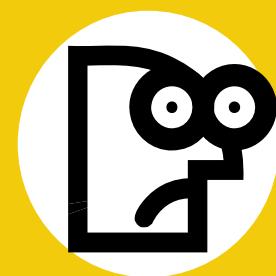
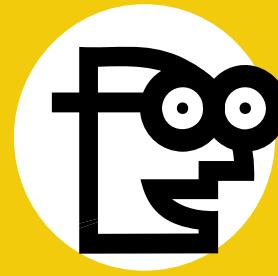
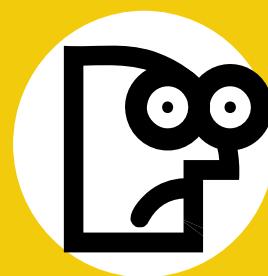


Benzene with Supor Membrane



Check These Out!

- Average Borehole Concentration (ABC) applet
[www.epa.gov/athens/learn2model/part-two/onsite/ abc.html](http://www.epa.gov/athens/learn2model/part-two/onsite/abc.html)
- US EPA Region 1 Groundwater Sampling Protocol
www.epa.gov/region1/measure/well/wellmon.html



It's QUESTION TIME !!