

Results of Field and Lab Experiments on High Rate Land Application of Wastewater *RIBS – Update on Current Research*

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- **DGS**
- **UD Dept. of Civil and Environmental Engineering**
- **USDA ARS Penn State**

OVERVIEW – Land Based WWD



How to avoid or manage risks?

- Public and environmental health
- Problem mitigation

- Development & Income
- Costs for wastewater treatment and disposal



Ground Water Benefits and Risks

- Recharge does occur
- Potential for re-use
- Contamination of key water resource
- Site specific flow details uncertain



■ Monitoring is key risk management tool

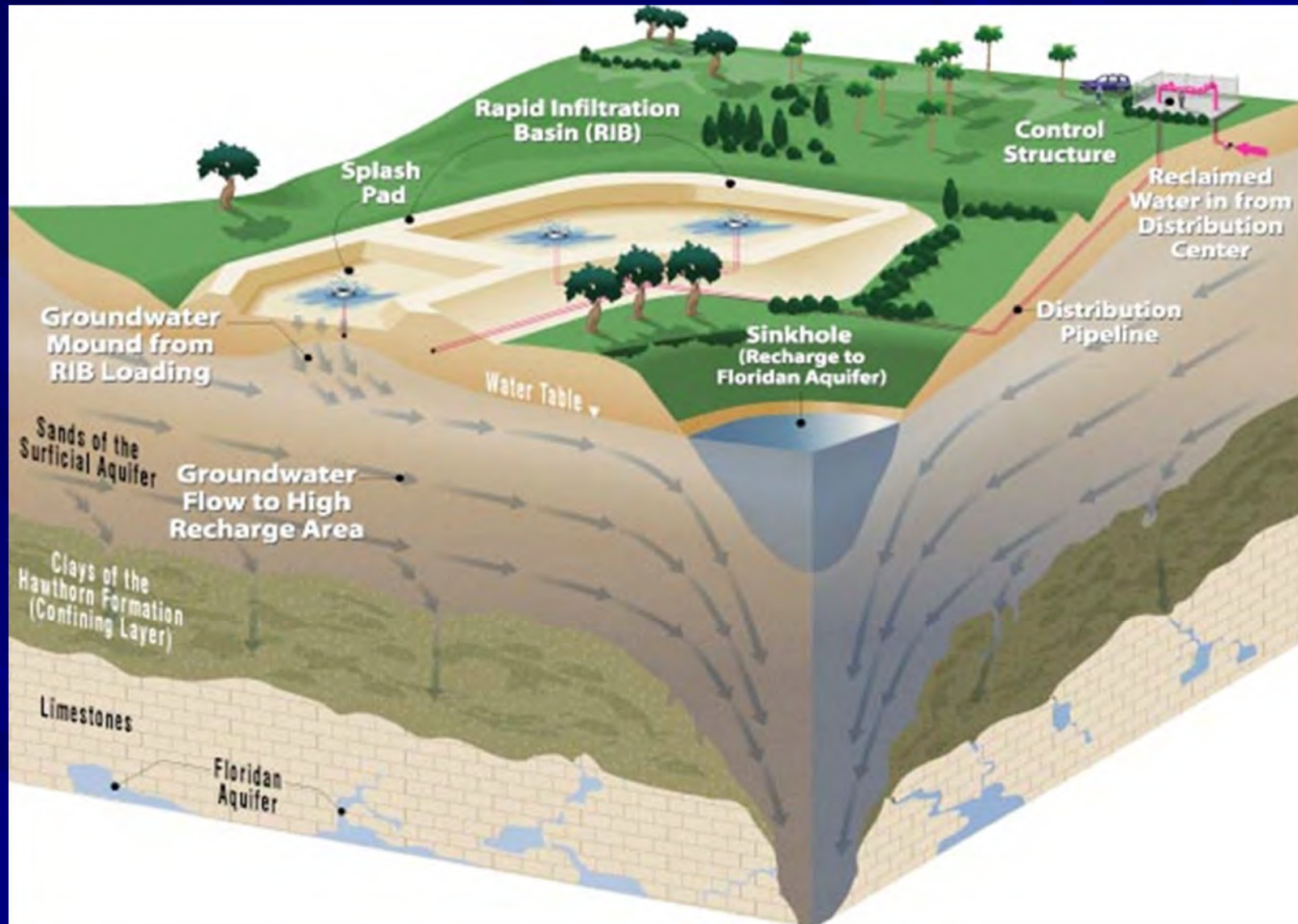
Rapid Infiltration Basin Systems

- Complex system – components in series
- Wastewater treatment plant
- Infiltration basins – high rate disposal, 10x Spray, 100x natural recharge
- Vadose zone (natural) treatment
- Diffusion/dispersion of water and solutes in aquifers

RIBS

- Many misconceptions, miscommunications
- Decades of operational history
- Most common in arid areas, and locations that have fresh water supply issues
- Potential part of water reuse system
- High loading > smaller land requirement
- Some design standards based on 1970's work and national-scale considerations
- Point source or non-point source regulation? What about ag standards?

Recharge of confined aquifer – Florida



Source: Water Conserv II -http://www.waterconservii.com/rib_anatomy.html



Illustration source: Tuscon Water

RIBS Research

- Phase I – Multi-state treatment plant performance, site visits, comparison of state regulatory programs
- Phase II Field experiments - infiltration beds, vadose and saturated zones, characterization/monitoring systems, literature search
- Phase II Modeling experiments – field site simulation, comparison of modeling approaches, GIS screening tools
- Phase III Reporting and wrap up
- Parallel SWRI project on vadose zone
- Parallel UD/USDA project on chemical testing

Phase I Results

- Treatment plant performance shows mixed success – periodic plant “upsets”, some “lemons”, start up and capacity “gotcha’s”
- Other states have adapted engineering, regulation, and policy to water and development needs and environmental/public health risks
- DE public and environmental health risks are significant and different from other states
- DE regulatory and administrative programs are nearing completion, proposal to tighten treatment, engineering, design, and monitoring requirements

Phase II results

Infiltration beds



Small to
large



When things
go wrong...



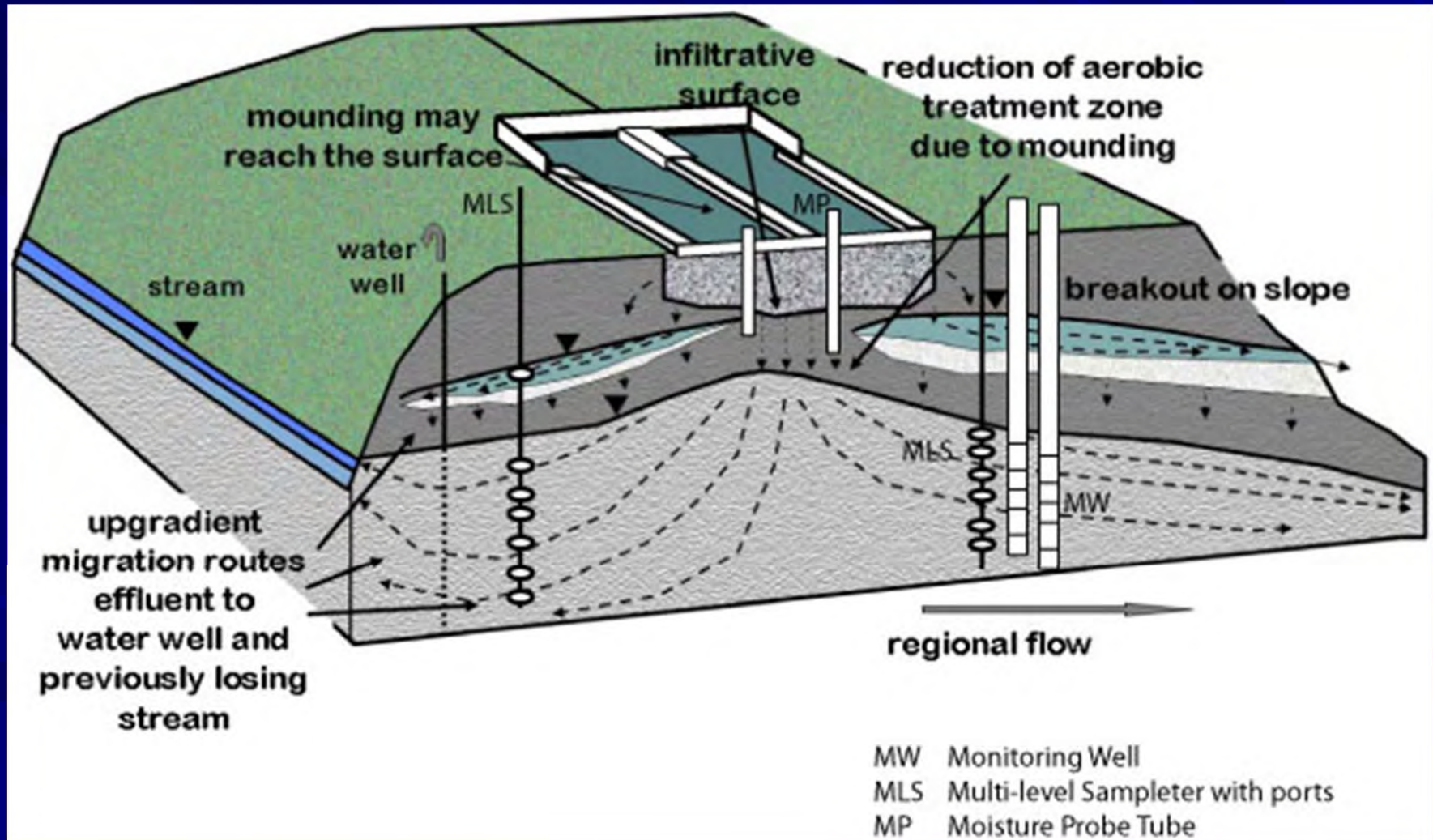
It's a show
stopper !



Infiltration risks and planning

- Too *slow* or *fast* problems caused by...
- Inadequate site characterization & facility design – *MAGIC SAND* issue
- Poor quality effluent and application practices
- Maintenance
- Monitoring systems
- Alternate disposal plans common

Phase II Field Experiments

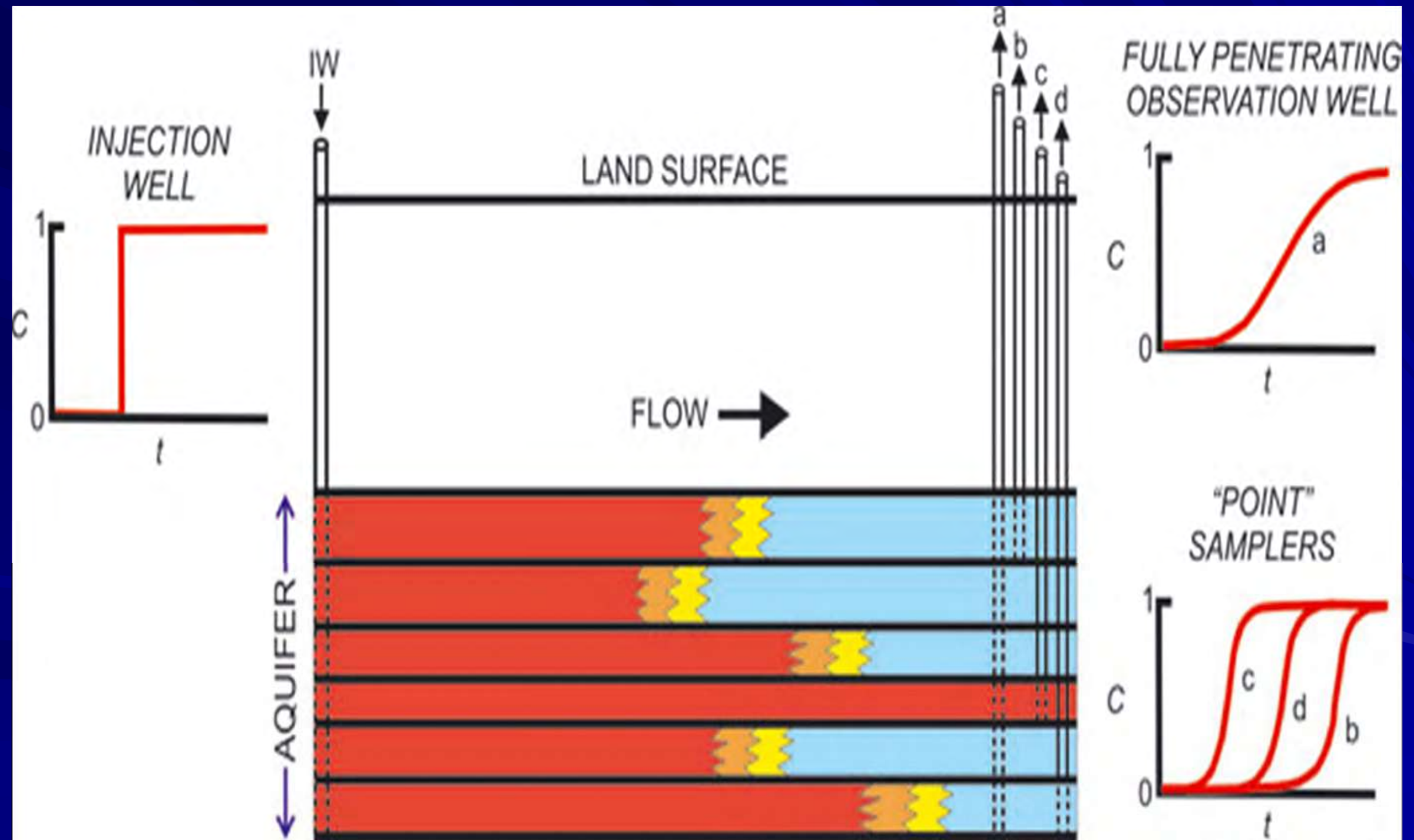


A “sophisticated research” monitoring system



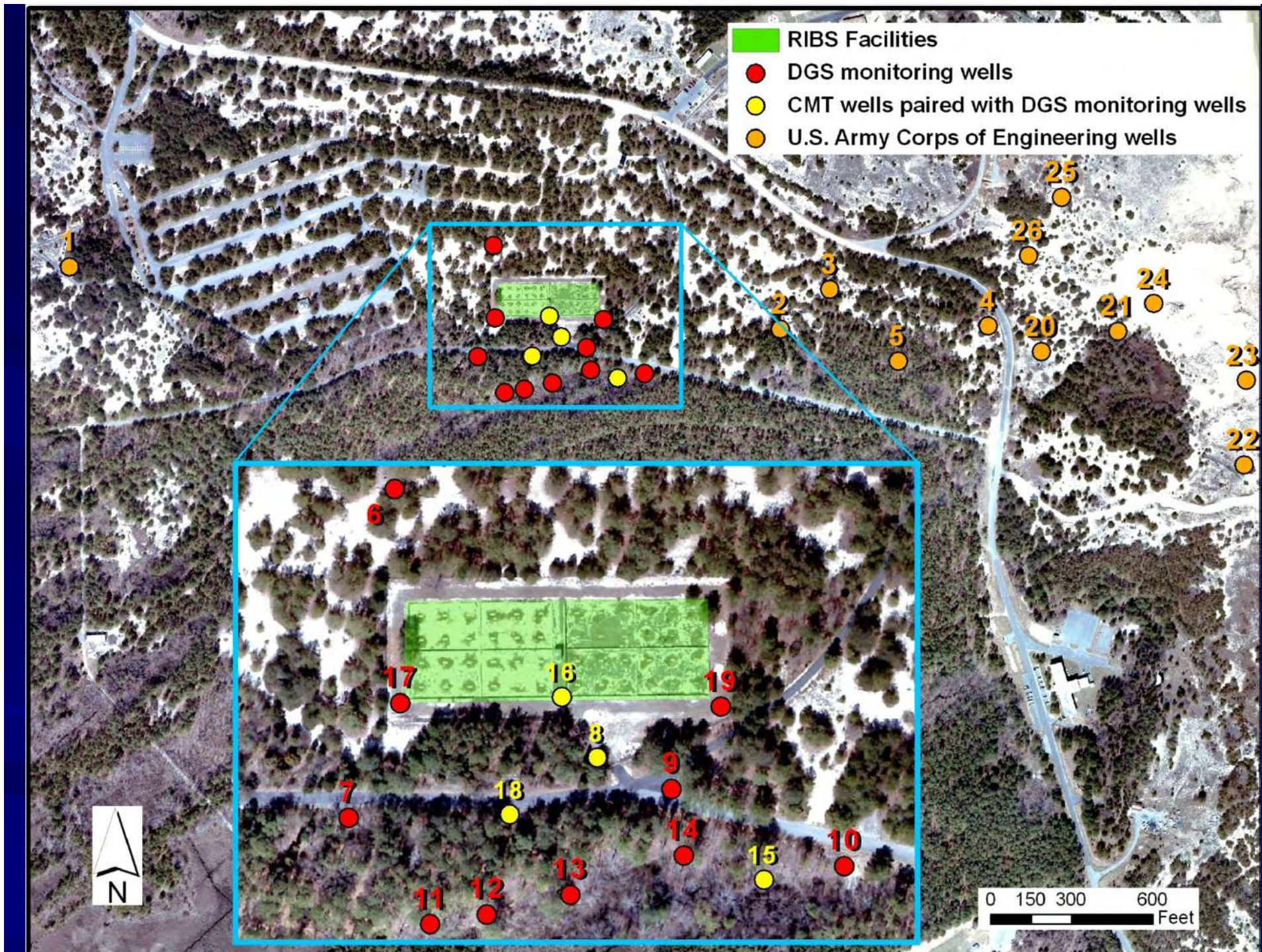
MMR national research site, Cape Cod, MA – source USGS

One result Complex flow characterization

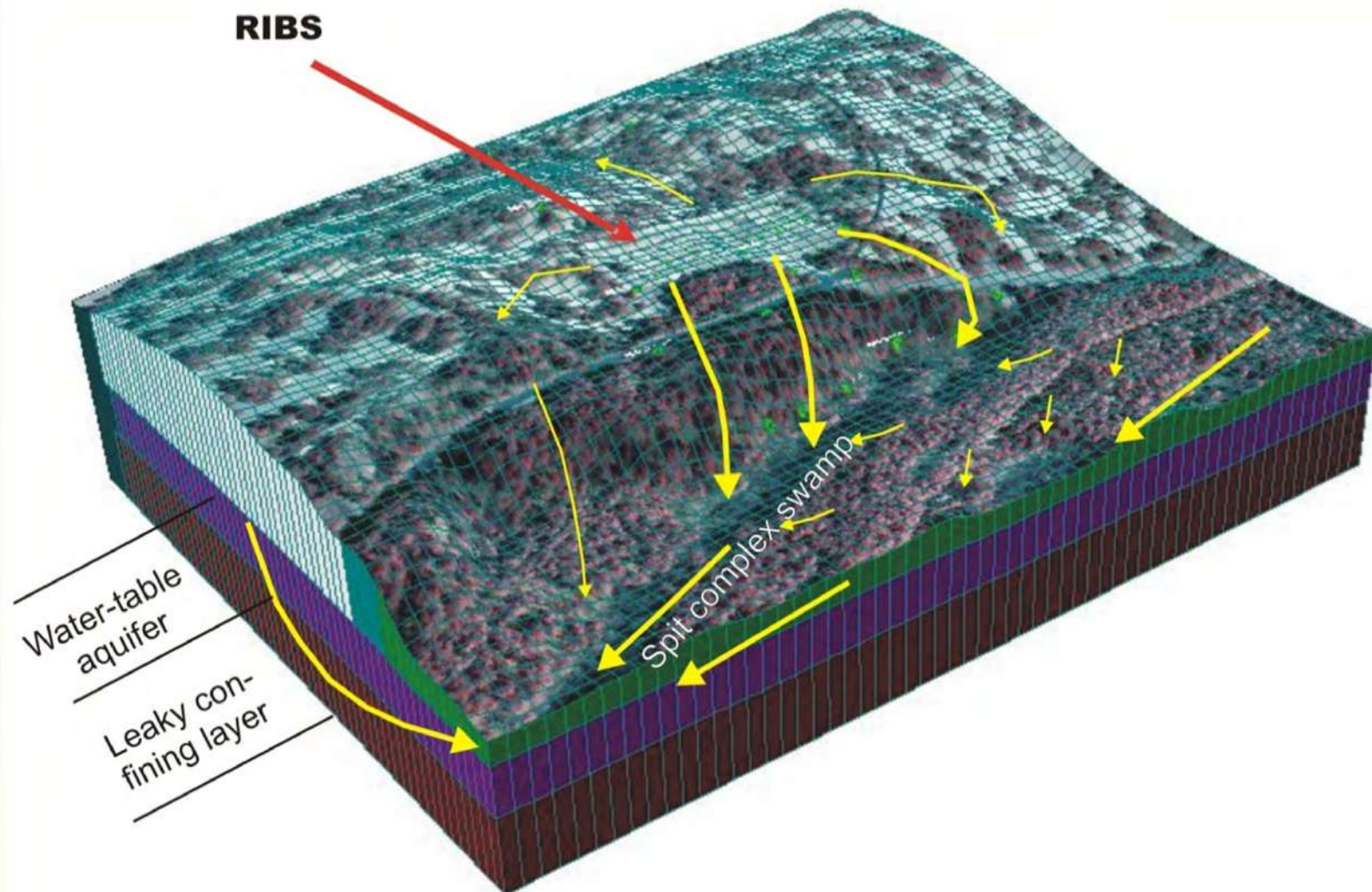


Research is
affordable, but
resource loss may
not be!

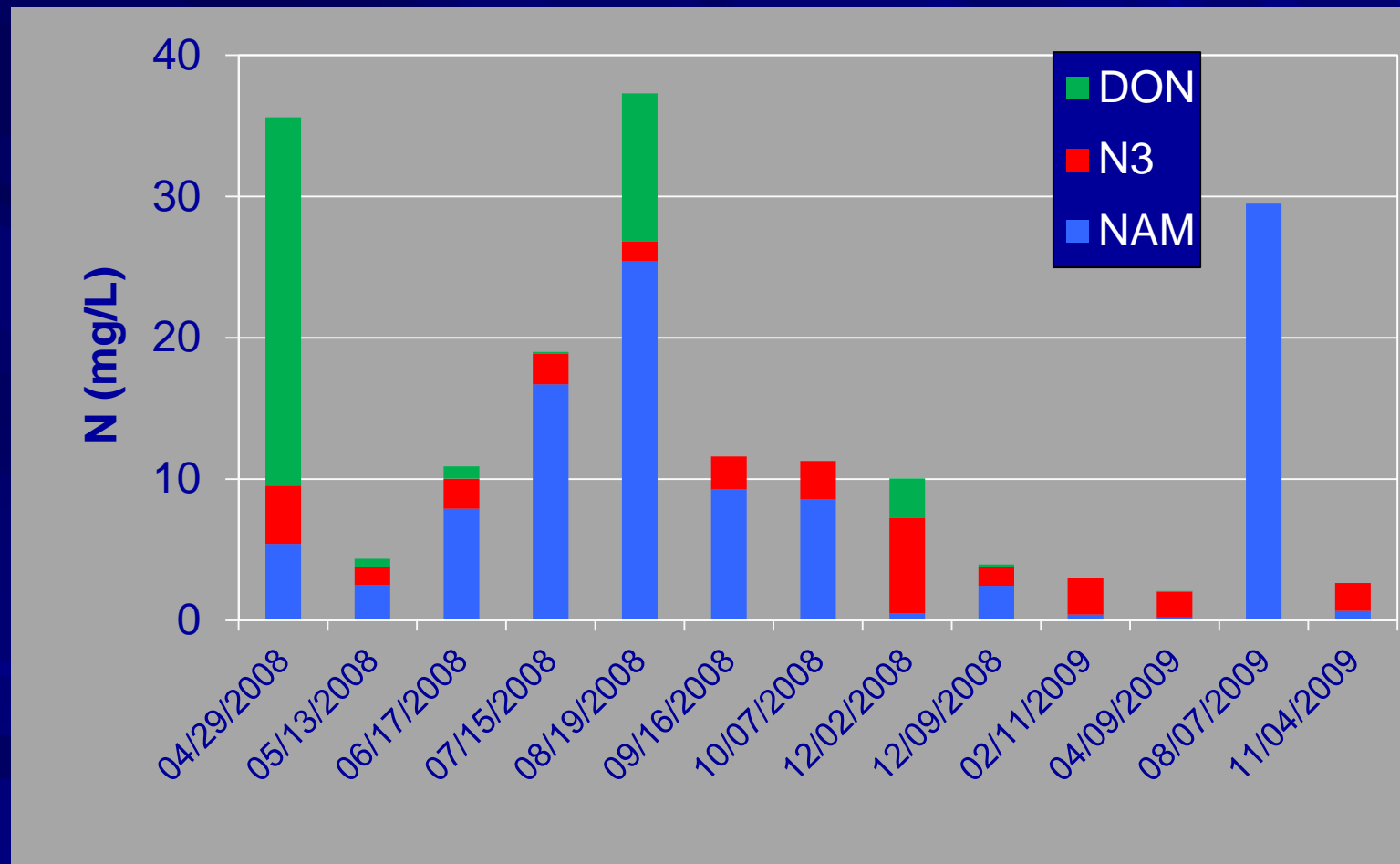




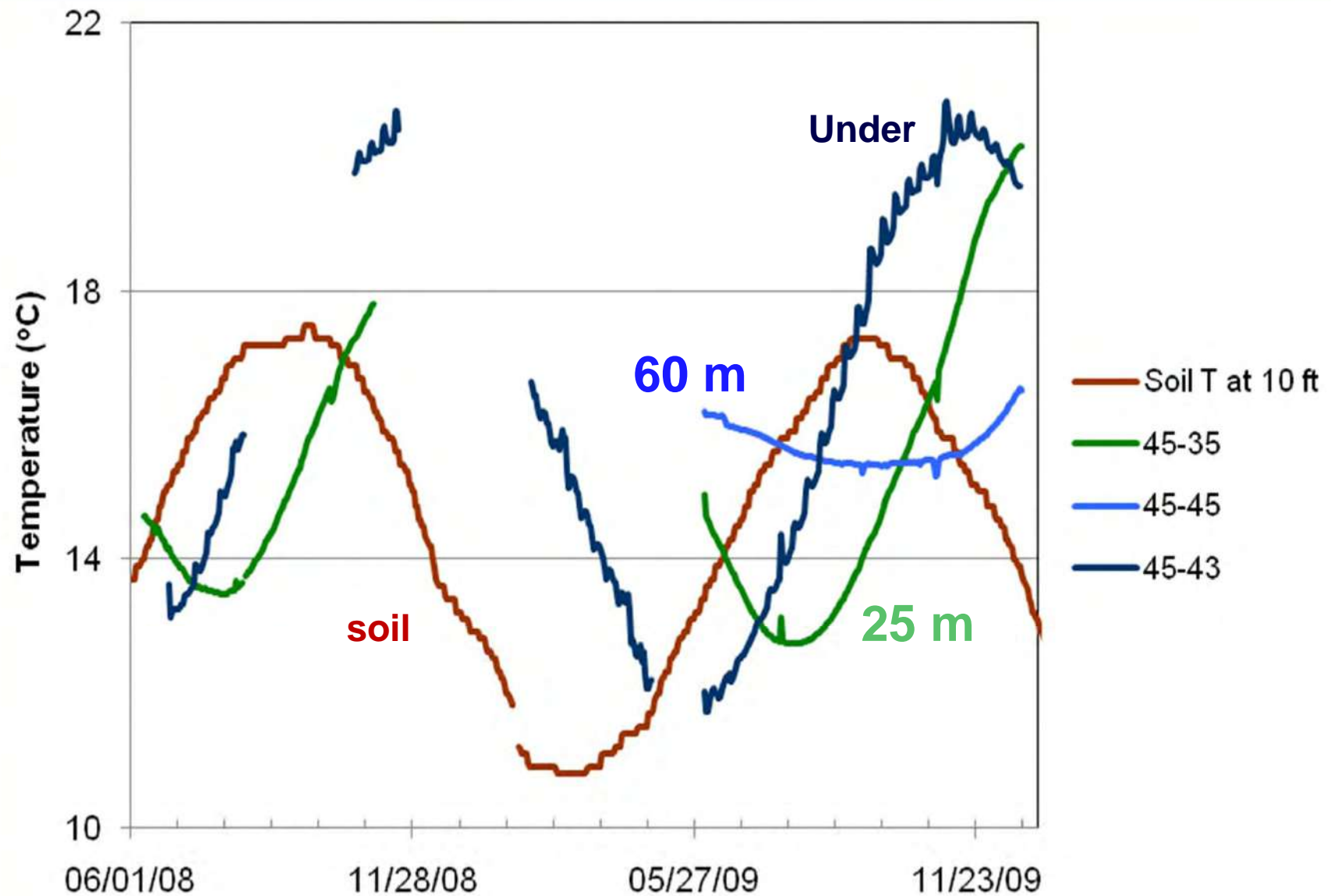
To minimize risk – **know** where contaminants are moving



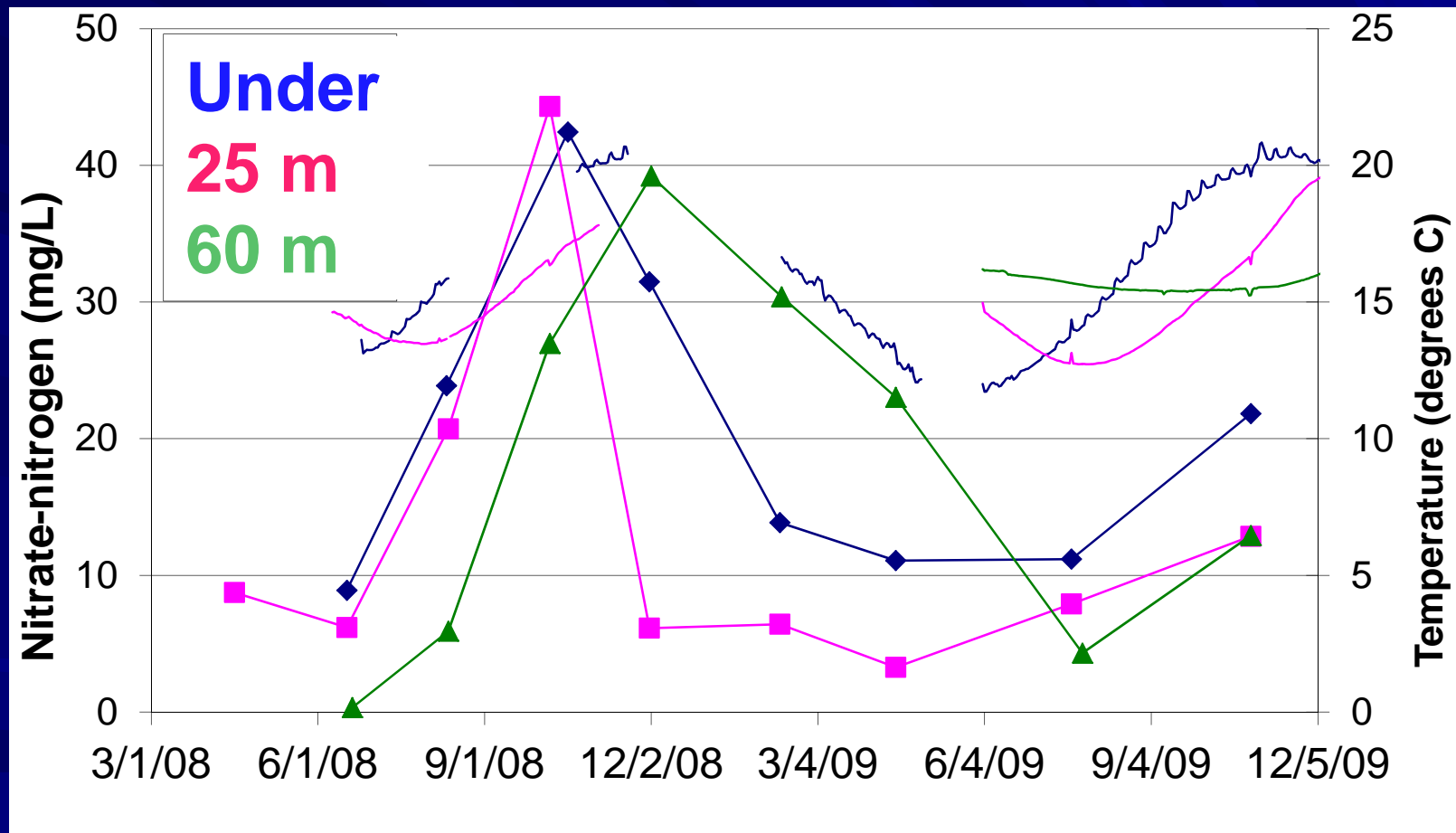
Frequently sample effluent quality – don't assume



Tracing Effluent in Groundwater



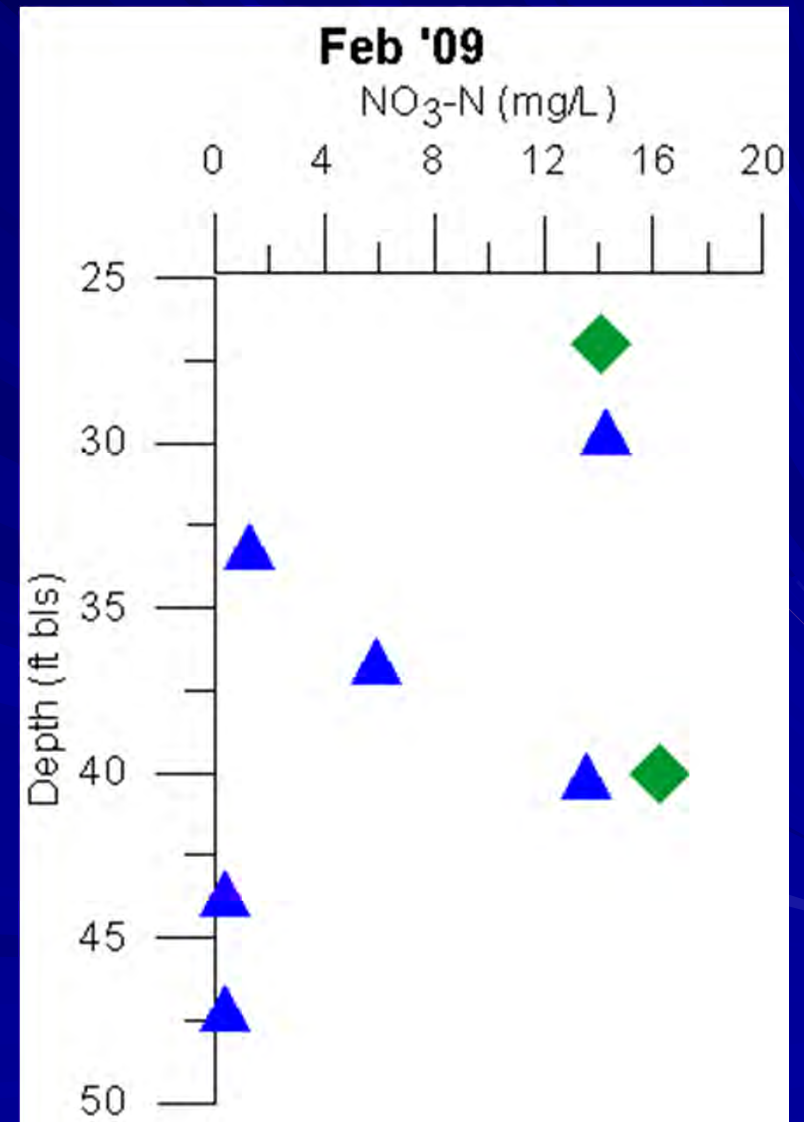
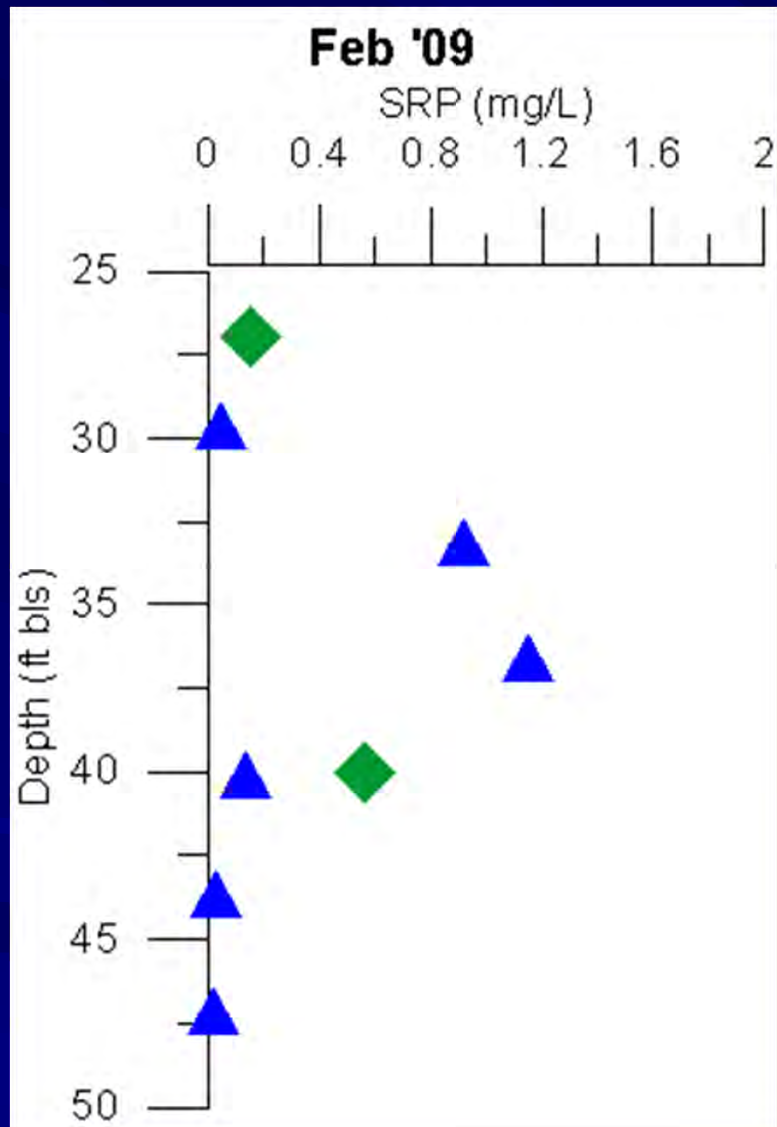
Tracing effluent in groundwater



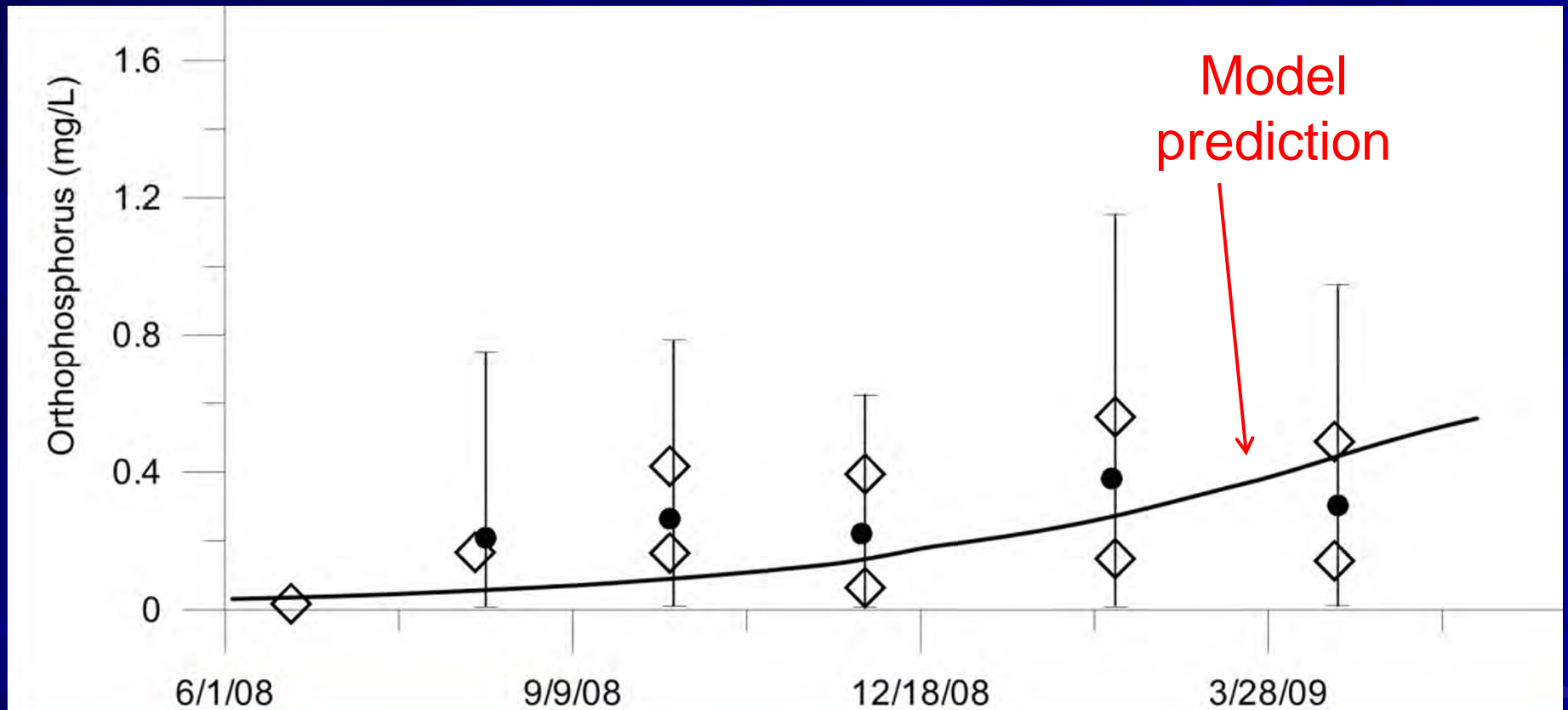
Infiltration issues and risks

- Little to no contaminant removal once past this zone and in an aquifer!
- Breakthrough of applied contaminants, mobilization of pre-existing contaminants
- Very complex system – low risk design requires extensive work
- Problem diagnoses and fixes are costly
- 1970's design does has little treatment benefit

Monitoring issues

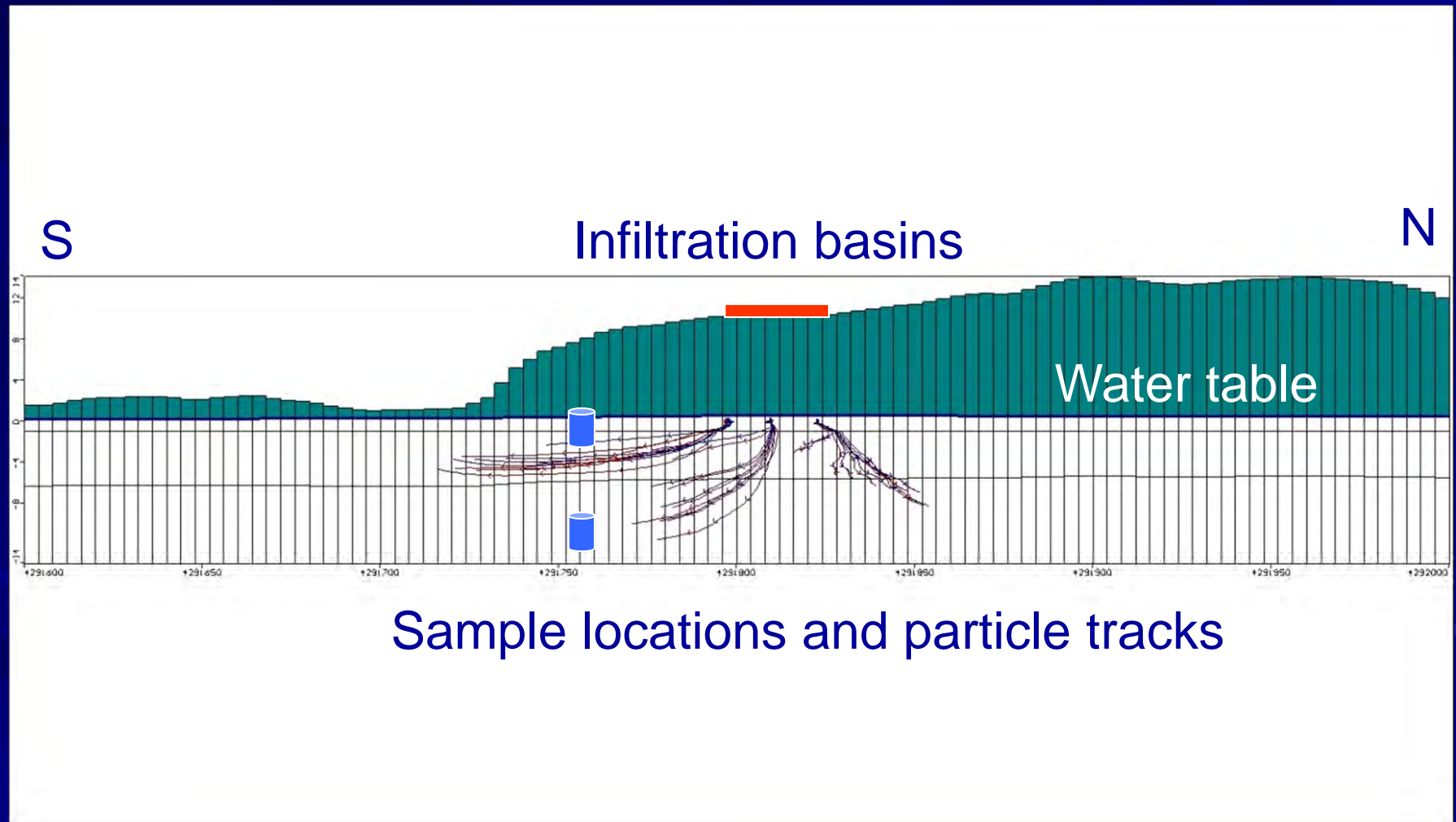


Transport models are only a probabilistic tool, not the truth



P moving significant distances from disposal area

Simple monitoring systems & models routinely misinform



Let's talk about P

- P is mobile in DE groundwater
- Environmental but not public health standards
- DE Nutrient Mgt Commission has adopted very explicit guidance about P application and spends millions of dollars on P capture & relocation
- Ag community spends many \$ on P
- Is wastewater P getting the correct attention?

SUMMARY

- EPA guidance not appropriate for DE
- Contaminants not significantly attenuated
- Highly complex contaminant transport
- Mobilization of naturally occurring contaminants
- Monitoring very difficult to do correctly
- Modeling leaves false sense of security
- More results yet to come

Questions



Geologic Setting & Model Domain

