There's Wastewater in the Geology

Introduction to Current RIBS Research

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- **DNREC - USEPA**
- **UD Water Resources Center – State Water Resources Research Institute**
- **DGS**

OVERVIEW – Land Based WWD

Centralized Wastewater Treatment and Disposal – traditionally speaking…

- Public utility for the public good
- Provides ability to plan development
- More control over output of pollutants – location, amount, and concentration
- Long term source of revenue for government
- Many complex interrelated issues

Privately Owned Wastewater Utilities – new wrinkles on an old issue

- Ability to sell treatment services as an privately controlled commodity
- Some infrastructure costs shift from public to private sector
- Can bypass government planning and control over infrastructure and build out
- Economies of scale and land use – denser development with central treatment
- Zoning approval before environmental approval

How to avoid or manage risks?

- Public and environmental health
- Problem mitigation

- Development&Income
- Costs for wastewater treatment and disposal

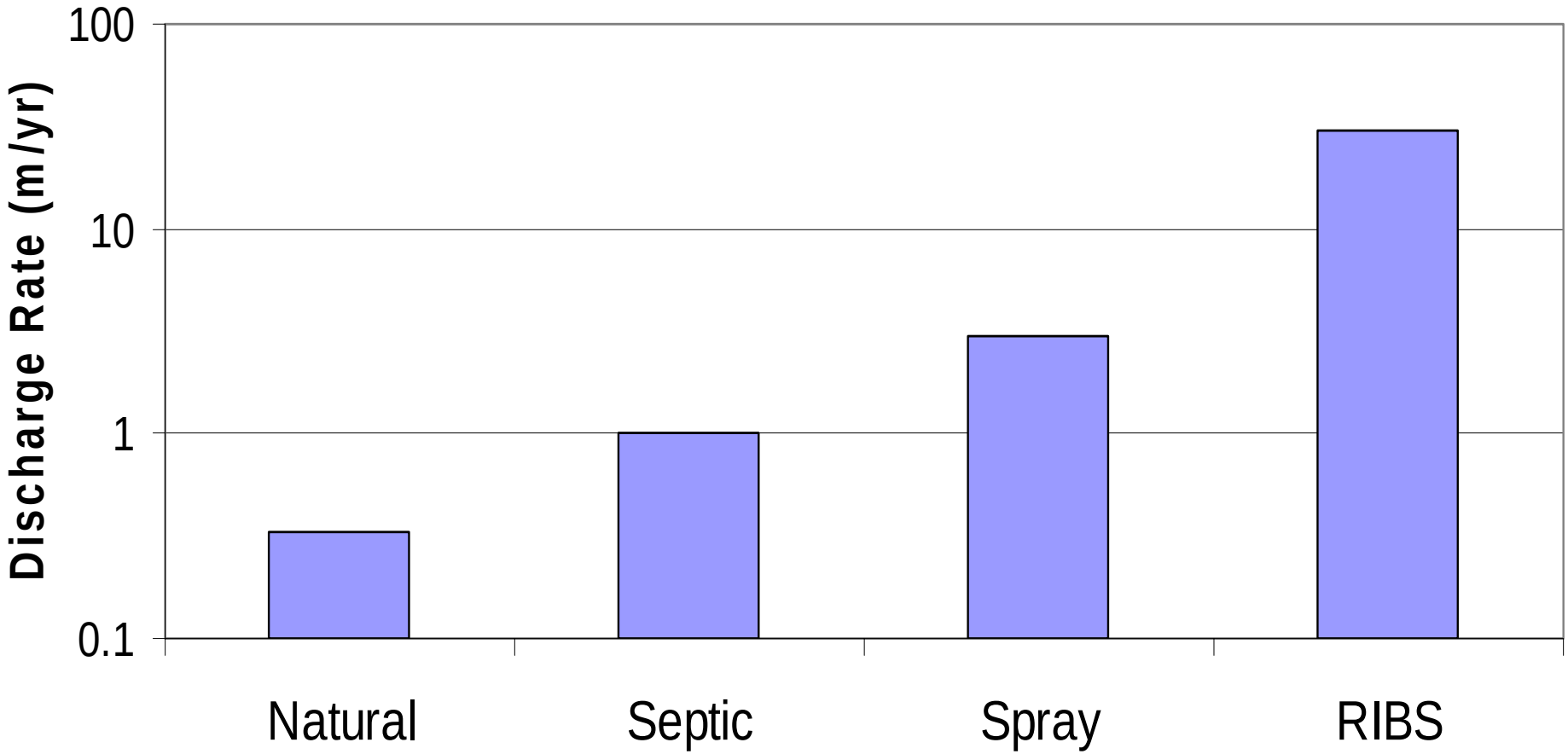
Rapid **I**nfiltration **B**asin **S**ystems

- High hydraulic loading rates of treated sewage effluent into the ground
- Wastewater treatment plant
- Infiltration basins
- Vadose zone (natural) treatment
- Diffusion/dispersion of water and solutes in aquifers
- Many misconceptions, miscommunications

RIBlets

- Decades of operational history
- Most commonly used in developing arid areas, and locations that are fresh water “poor”
- Water reuse and recycling
- Hydraulic barriers against saltwater movement
- High loading > smaller land requirement
- Regulation and standards are a “?”

Tale of Scales



RIBS Research

- Phase I – Treatment plant performance, site visits, comparison of state regulatory programs
- Phase II Field experiments - infiltration beds, vadose and saturated zones, monitoring systems, site characterization methods
- 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

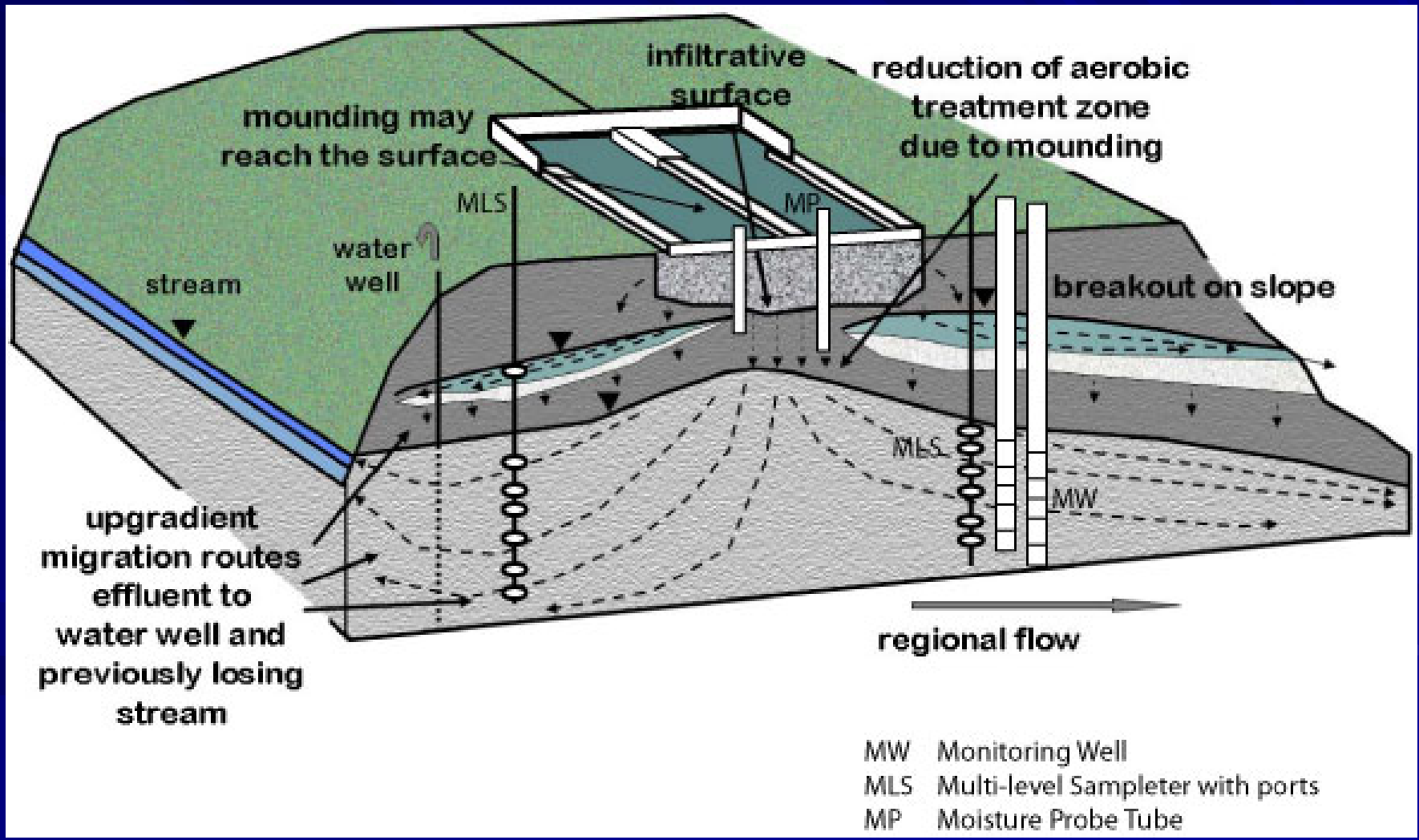
WASTEWATER TREATMENT & RIBS -

It’s in the sauce!

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 not complete
- Initial recommendations for siting and buffer distances

Phase II Field Experiments



Infiltration beds

Small to large

Flooding in action

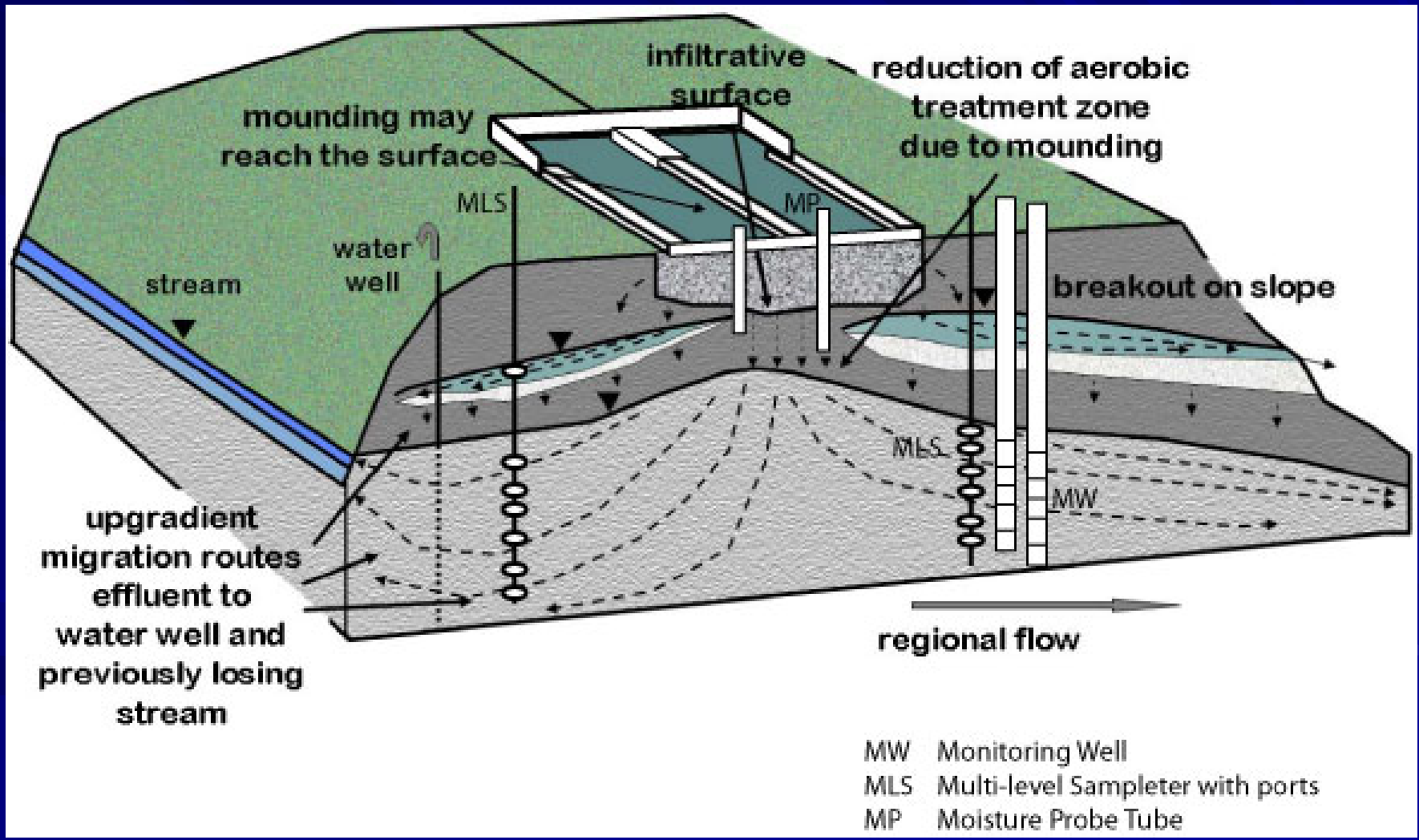
When things go wrong…

It’s a show stopper !

Infiltration issues and risks – Hydraulic Failure

- COMMON but AVOIDABLE
- Too slow and too fast problems caused by…
- Inadequate site characterization & facility design – reliance on MAGIC SAND
- Inappropriate infiltration bed maintenance
- Poor quality effluent
- Poor application practices

Phase II Field Experiments



Soil and Vadose Zone Treatment

- Backstop/supplement to treatment plant
- Effectiveness dependent on hydraulics – rates, timing, subsurface materials
- **N** - Mineralize, Nitrify, Denitrify…**P** - Mineralize, Sorb…**Pathogens, metals, organics, etc.** – predation, graze, sorbtion, mineralize, oxidation, precipitation…..

Infiltration issues and risks - geochemistry

- 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
- Reliance on MAGIC SAND

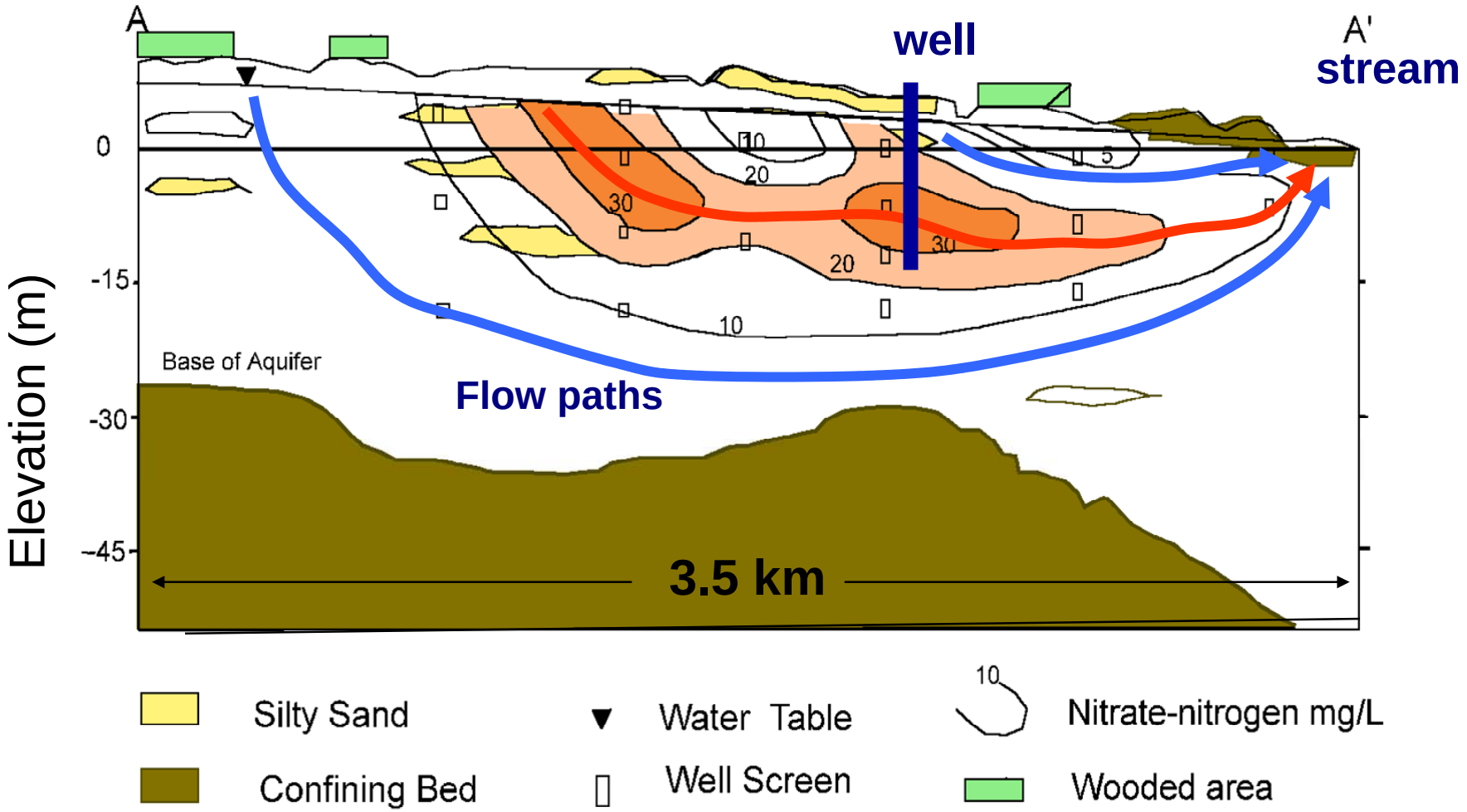
Ground Water Benefits and Risks

- Recharge does occur
- Potential for re-use

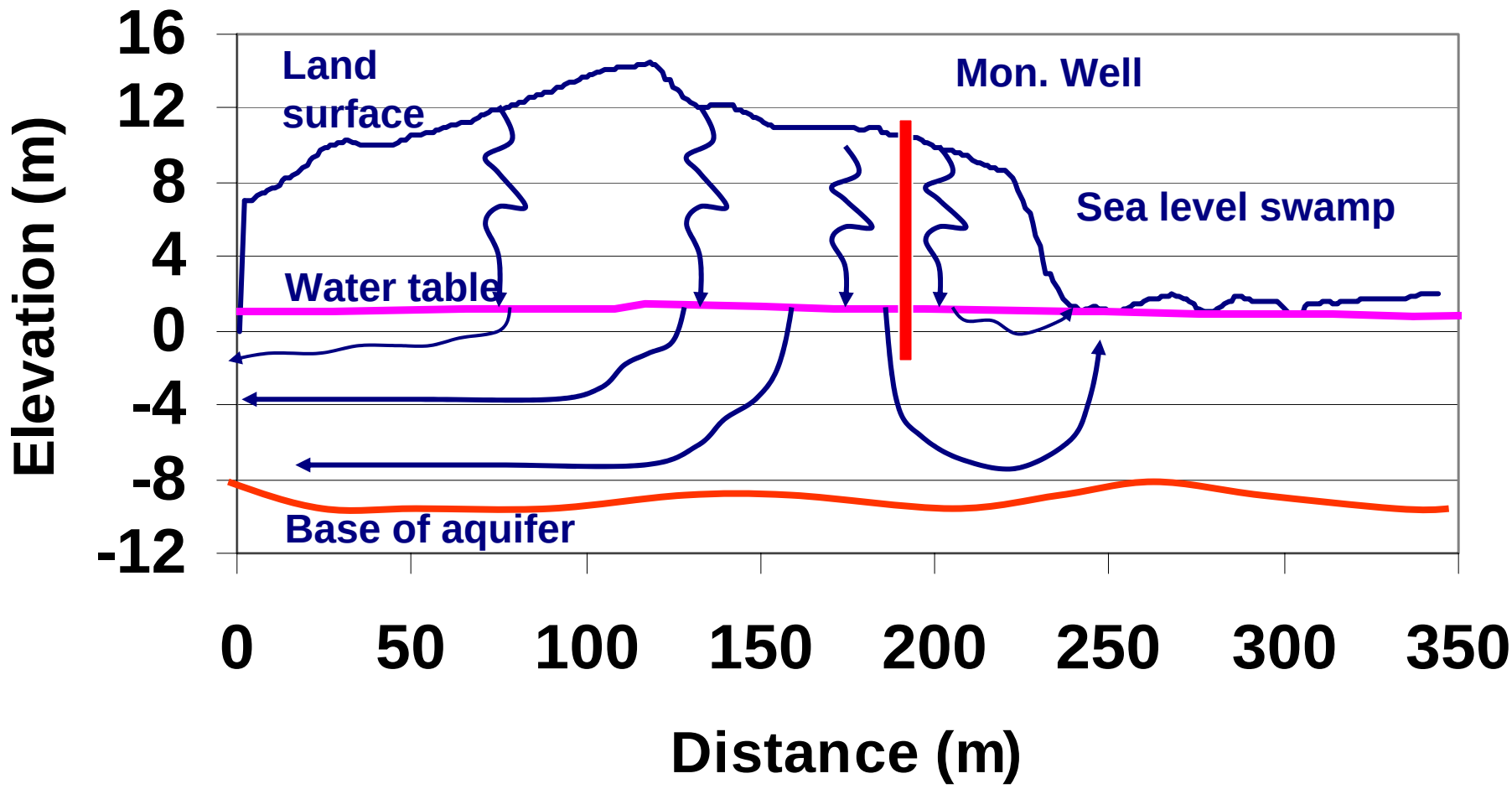
- Contamination of key water resource
- Site specific flow details uncertain

- Monitoring is key risk management tool

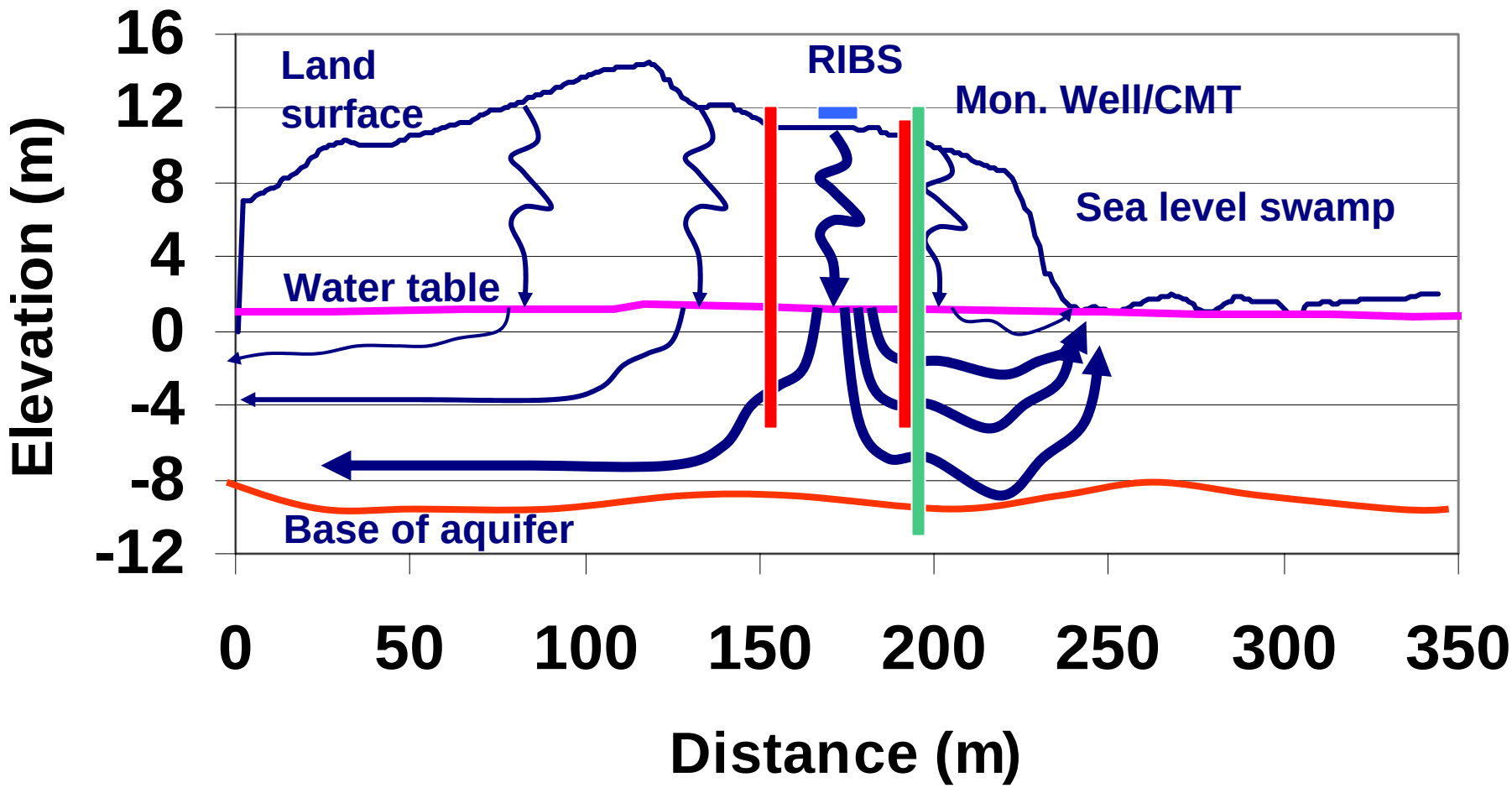
Risks - Regional transport of contaminants, contact with sensitive receptors
Proper design and monitoring reduce risk



Flow Paths – Pre RIBS

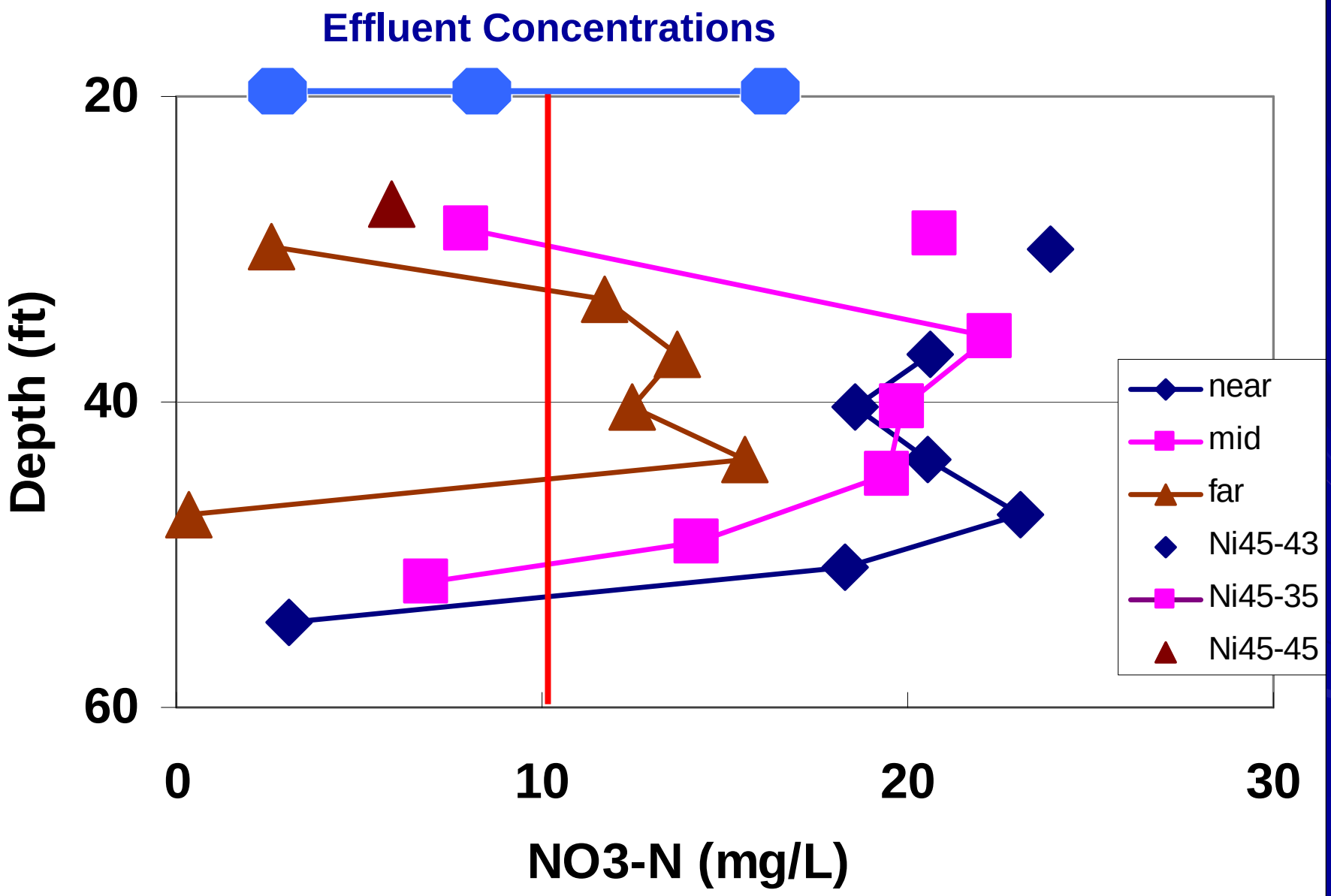


Flow Paths – with RIBS



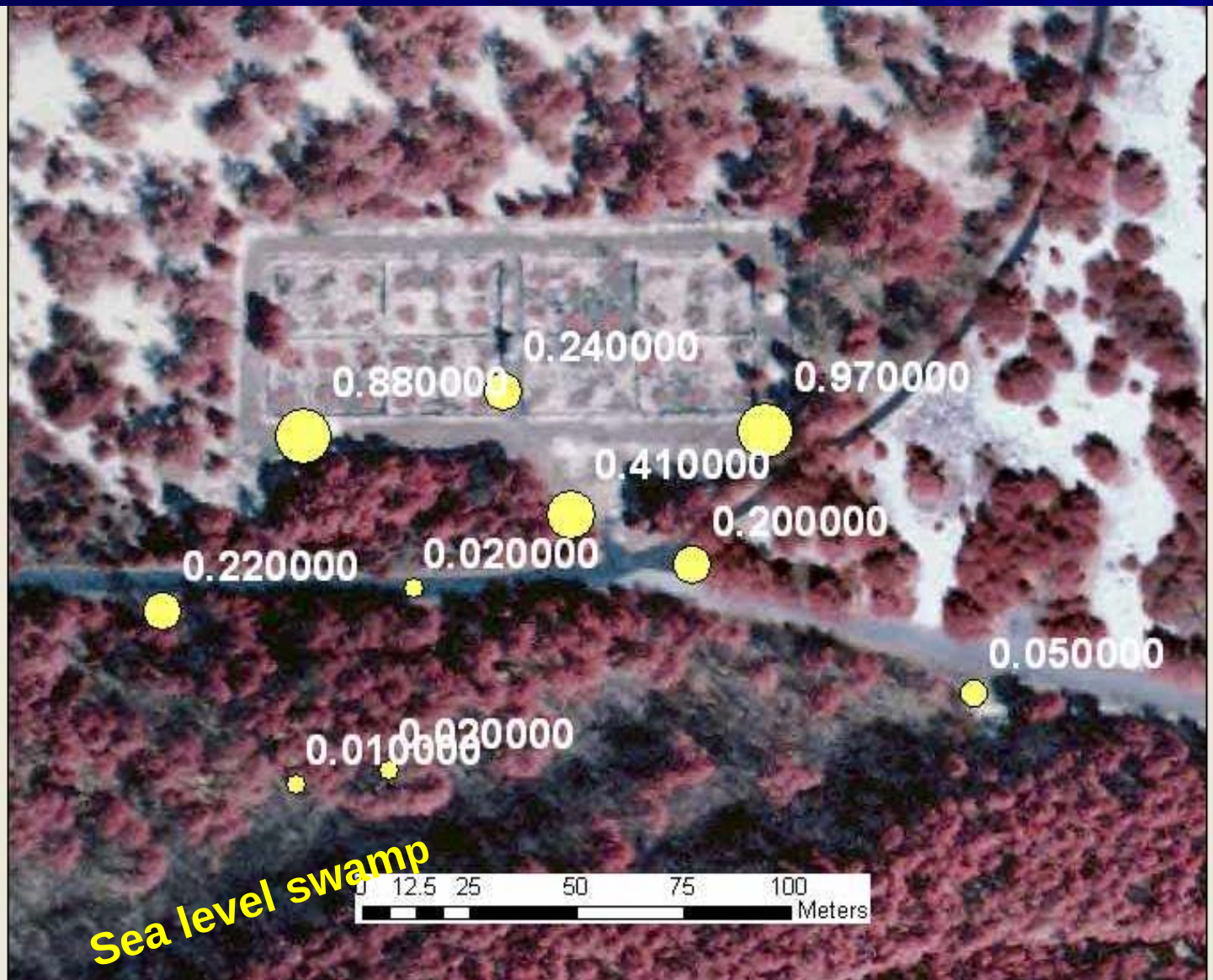
Testing Vertical Variations in Chemistry

Vertical variability

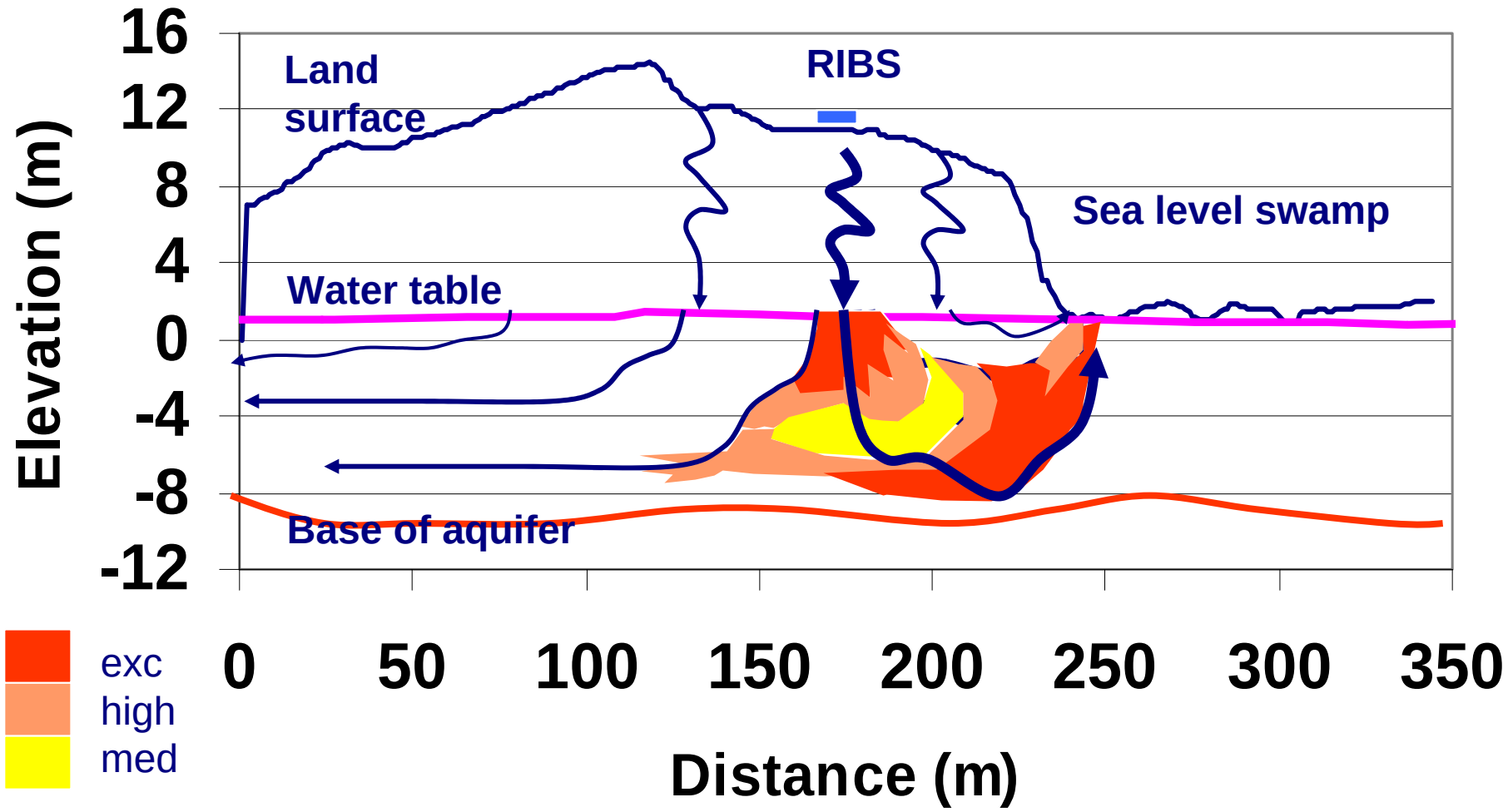


Nitrate – horizontal variability

SRP – horizontal variability



Flow Paths and Transport



No time to discuss details/ please stay tuned!

- Geology wrt GW quality, GW flow
- SEDIMENT CHEMISTRY – As IN MARINE DEPOSITS WITH SULFIDES!
- INFILTRATION EXPERIMENTS
- FLOW AND TRANSPORT MODELING
- “EMERGING CONTAMINANTS”
- SITE SCREENING TOOLS

Questions