Groundwater-Surface Water Interactions Region 4, 5, and 8: Theory and Practice

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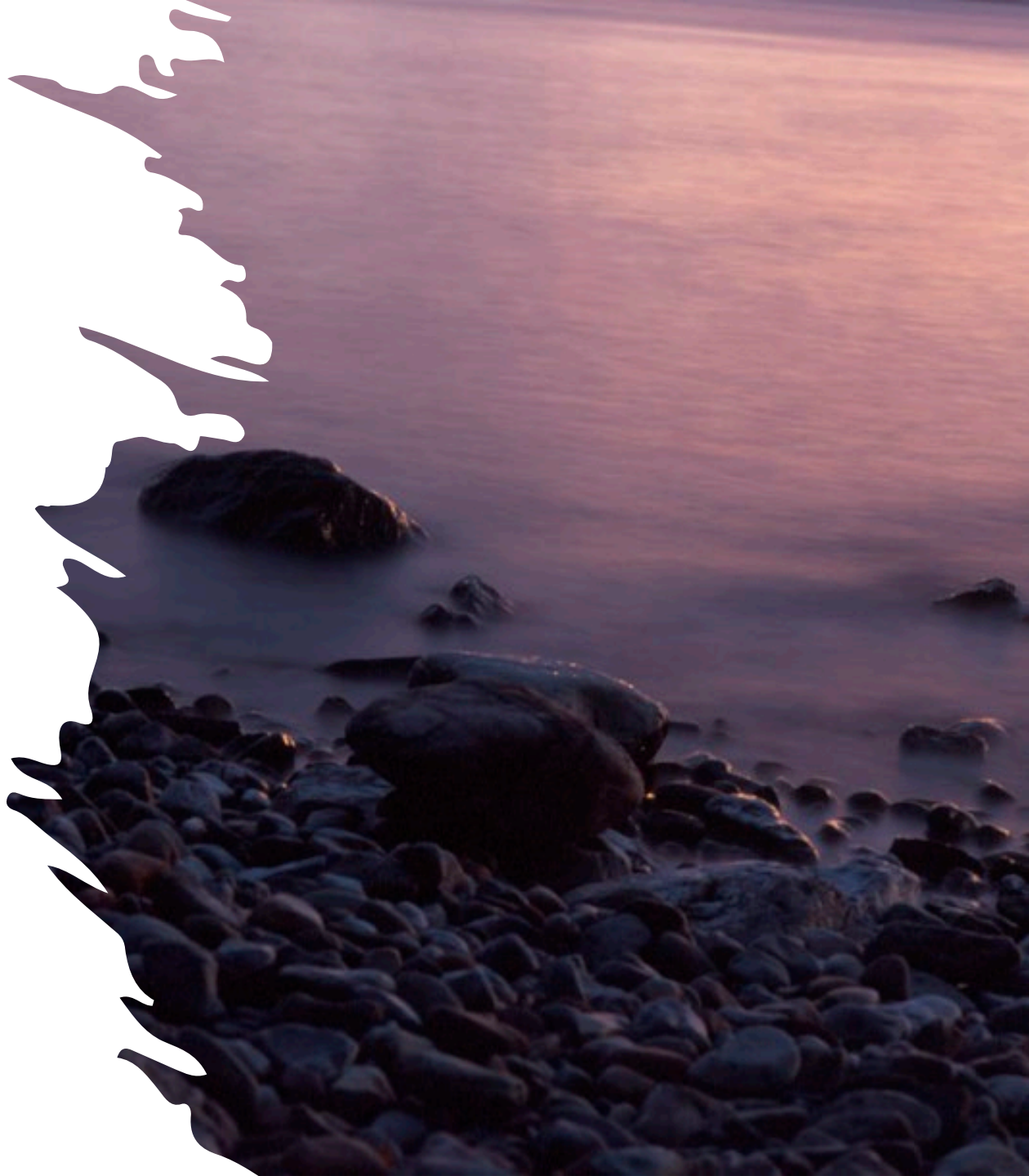

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What is the Current Groundwater Forum Mission?

- Support **Technology Transfer** for GW Characterization and Remediation
- **Build Consistency** Between EPA Regions in Application of Guidance
- **Develop** Issue **Papers and Fact Sheets** on Pertinent Topics
- **Review and Comment** on Groundwater Guidance, Publications, and Documents

Who Makes Up the Groundwater Forum?

- Hydrogeologists from Each Region
- Geologists, Scientists, and Engineers from ORD and HQ
- State Participants

- Voting Members
  - Regional Employee
  - Support RCRA or Superfund
  - Geology Degree or Substantive Geology Experience

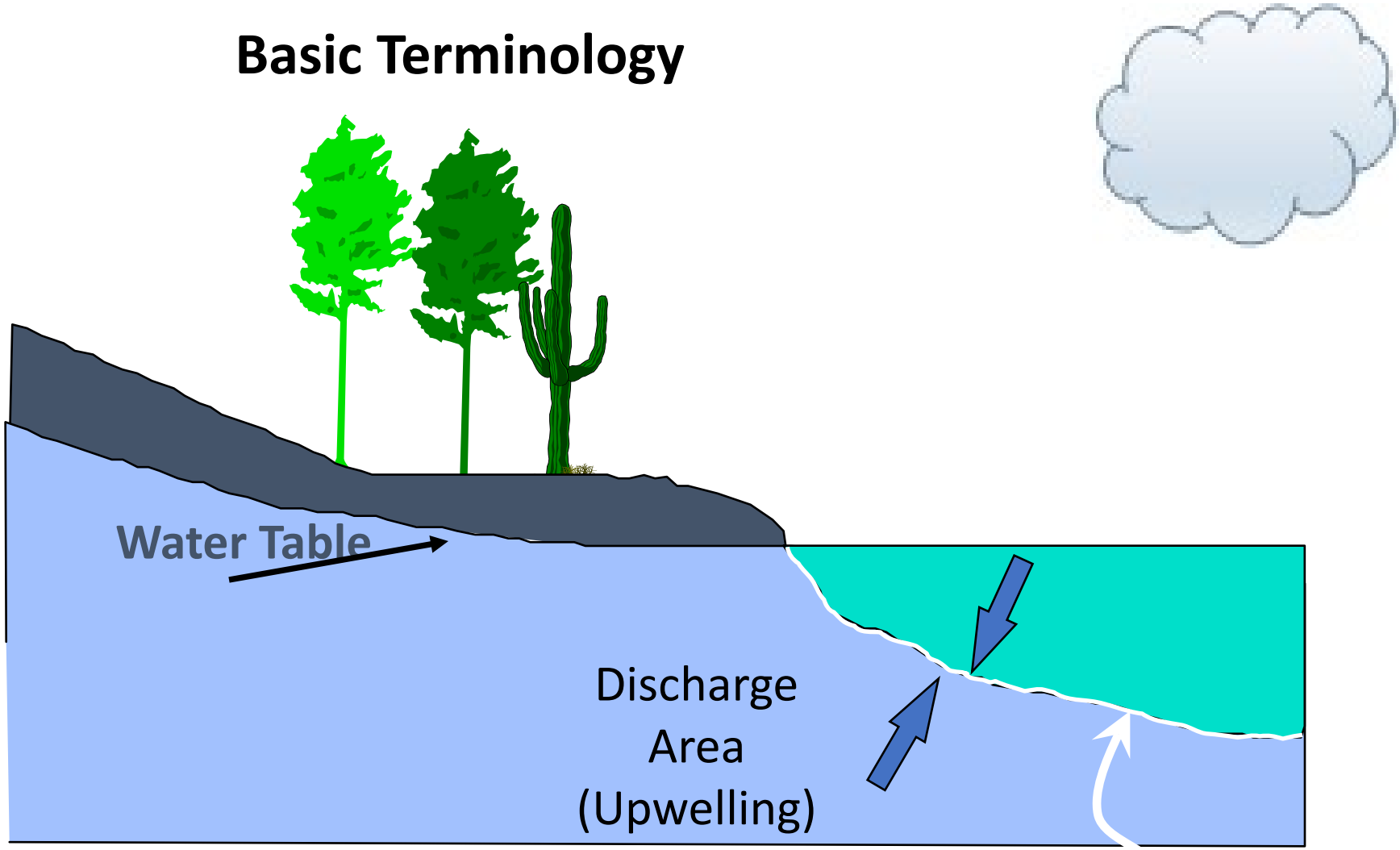
Conceptual Model

Groundwater Surface Water Interactions:

Southeast and Midwest US

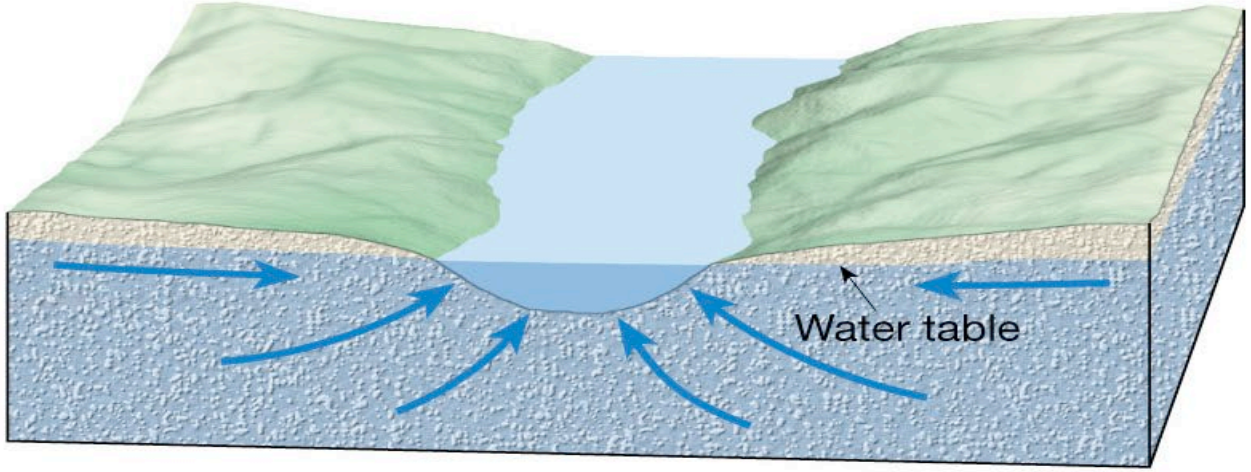
Note: Ian will cover Region 8 disconnected streams later…

Basic Terminology

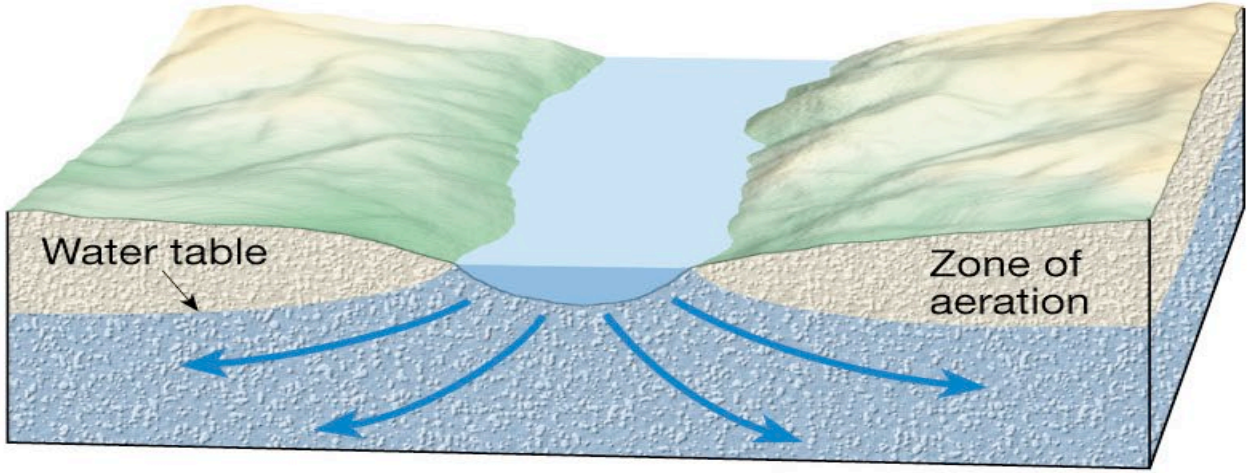


Transition Zone
Hyporheic Zone

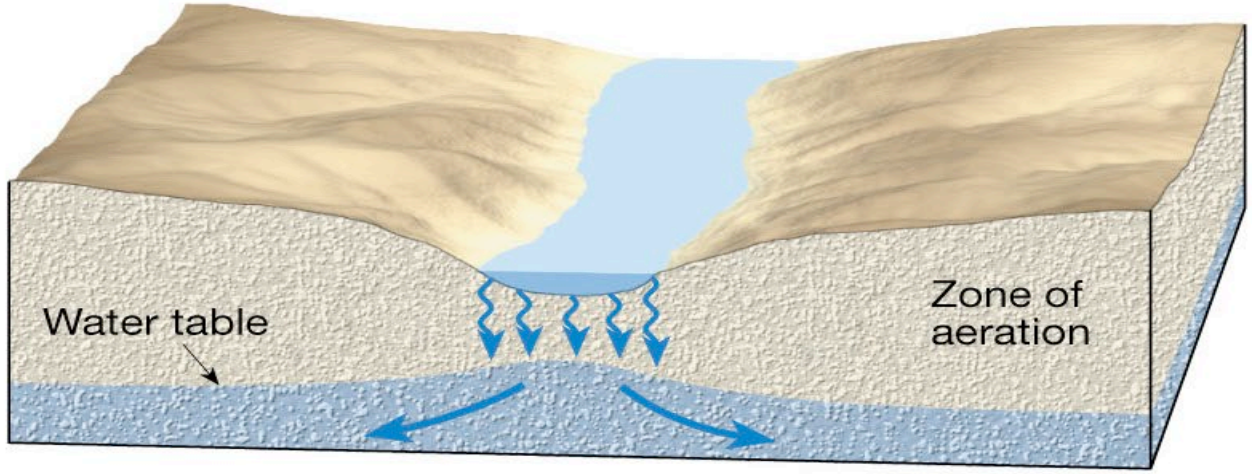
Gaining and Losing Streams



A. Gaining stream



B. Losing stream (connected)



C. Losing stream (disconnected)

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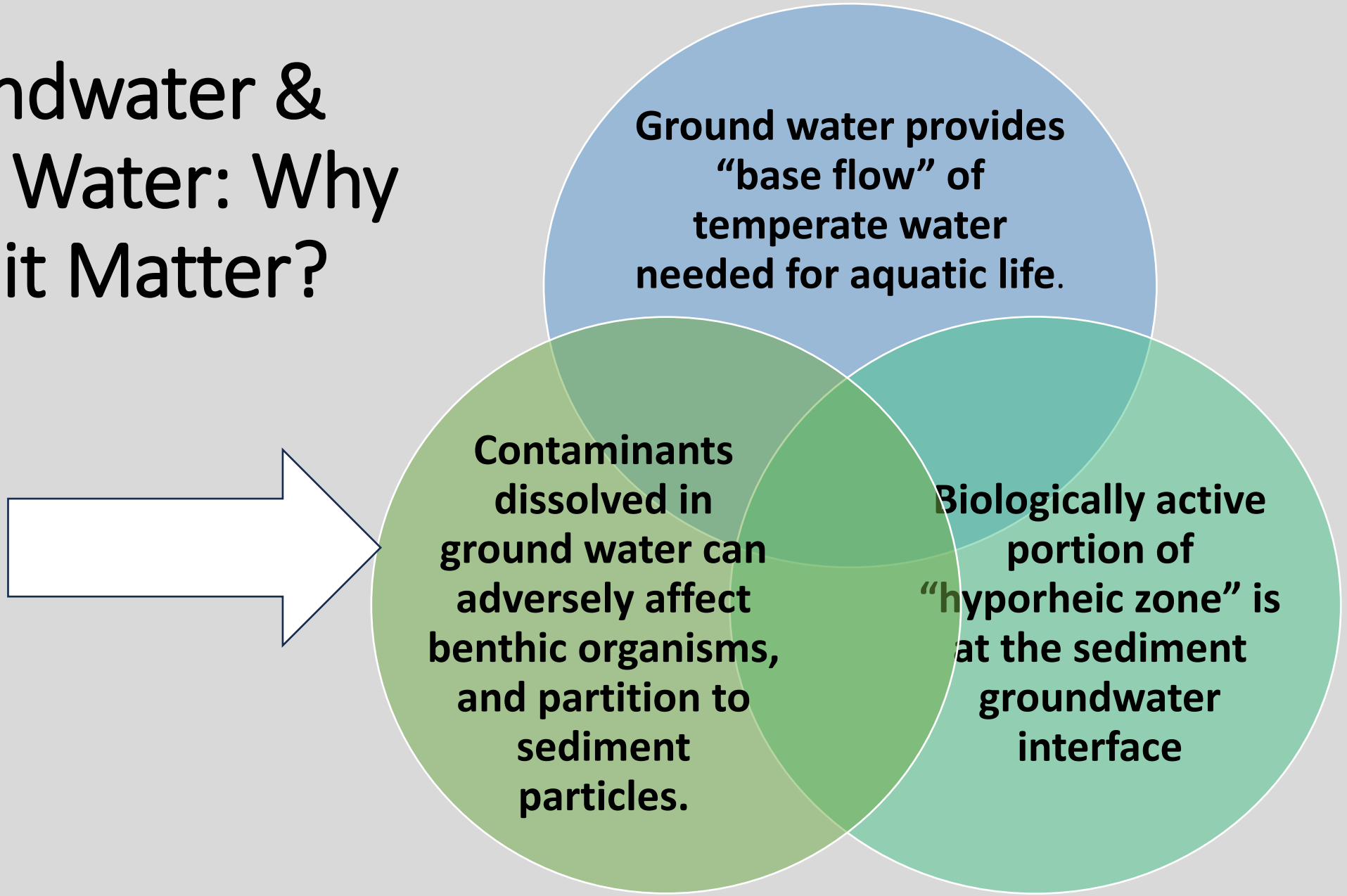
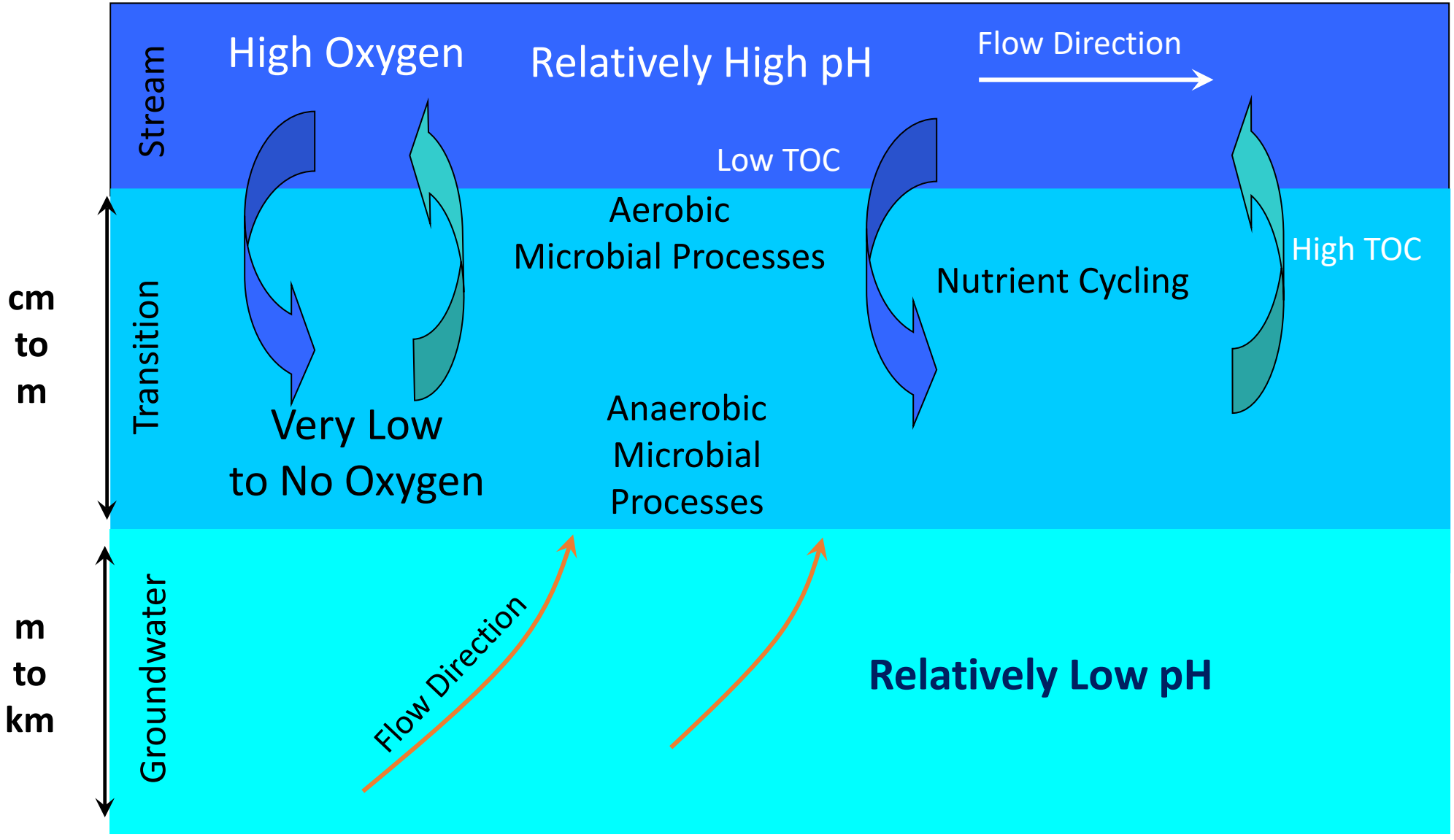
Groundwater & Surface Water: Why Does it Matter?



GW-SW Transition Zone Chemistry

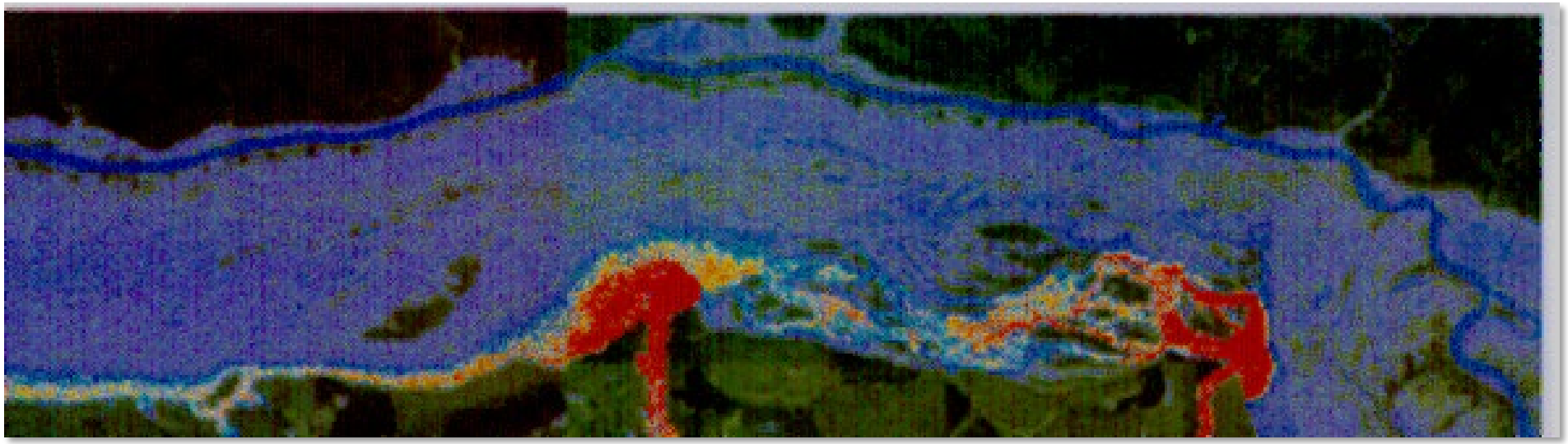


Hypotheses

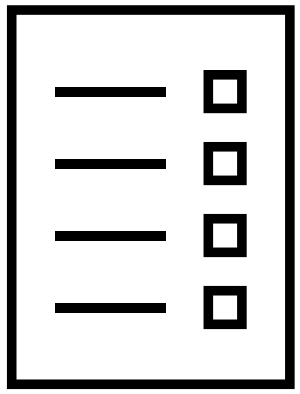
- **Groundwater Discharge to Surface Water Occurs Through Preferential Pathways, Usually Zones of Slightly Higher Permeability or Fracture Zones.**

- **Groundwater Discharge to Surface Water is Typically Not Broad and Diffuse**

Question: Where is the best place to collect a surface water sample to evaluate GW impacts?



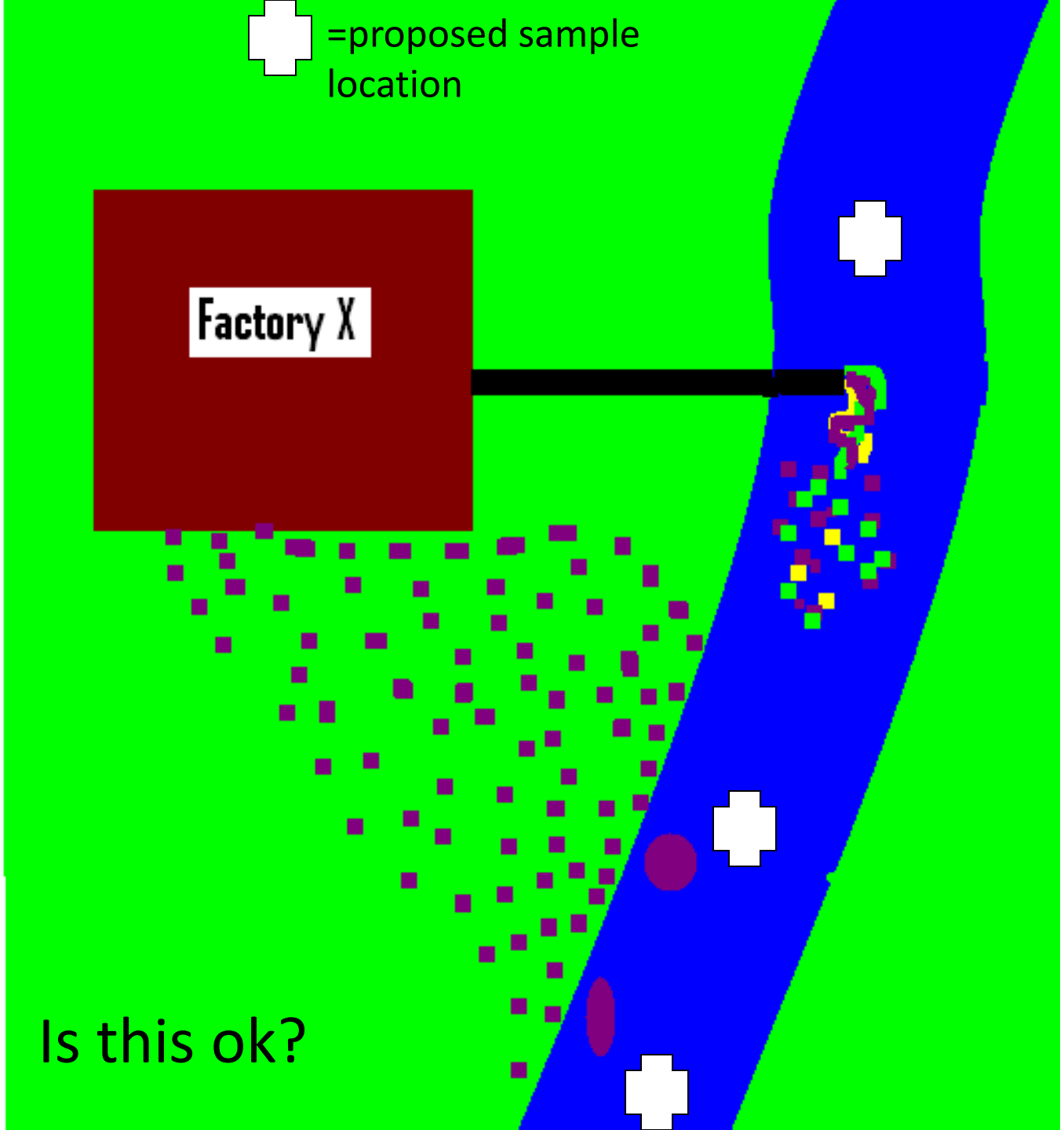
Answer: Where there is groundwater discharge.



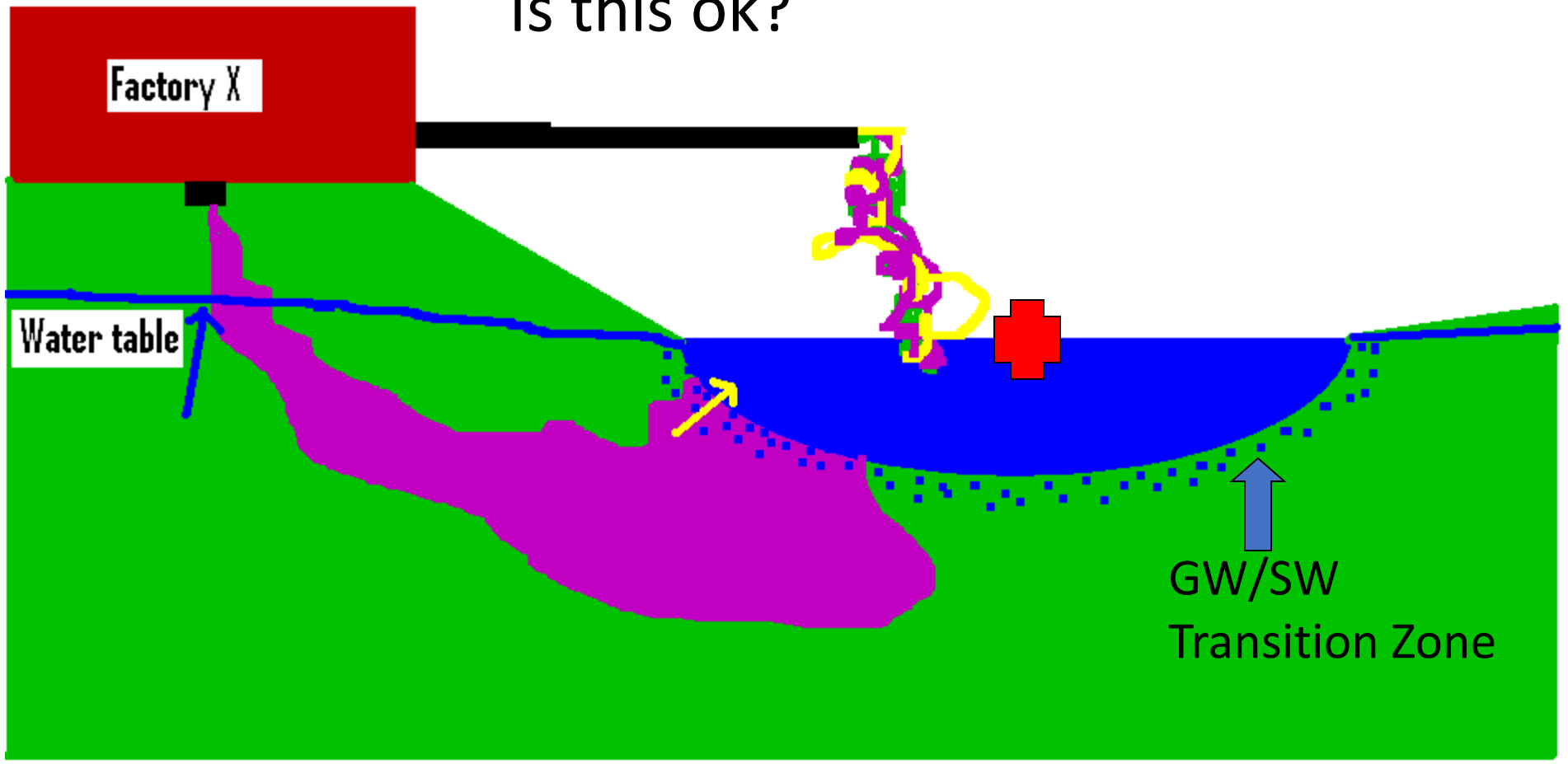
Let's hear from you…
Please respond to the poll

Where is the best place to sample surface water to identify impacts of contaminated groundwater discharge?

- Top center of the surface water body
- Bottom center of surface water body
- Top of the water column on the side of surface water body adjacent to the site
- Bottom of the water column on the side of the surface water body adjacent to the site


=proposed sample location
Factory X
Is this ok?

Is this ok?

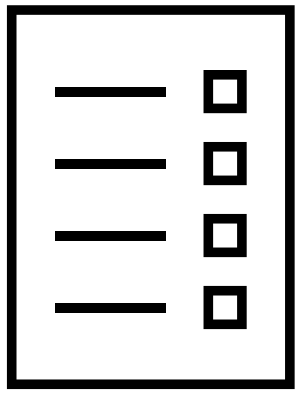


=proposed sample depth

How Do I Know Where Groundwater Is Discharging to Surface Water?

Rudimentary Methods to Evaluate GW Discharge to Surface Water

- Direct Measurements
  - Mini-Piezometer
  - Seepage Meter
- Field Observation
  - Visible Seeps/Color changes/Melted Areas
- Screening Tools
  - FLIR
  - Indicator Parameters
- Sampling
  - Diffusion Samplers
  - Push-point Sampling



Let's hear from you…
Please respond to the poll

Please mark each approach for evaluation of GW-SW interactions you have used:

- Seepage meter
- mini-piezometer
- FLIR
- Diffusion Sampling
- Push-point sampling
- Pore water sampling
- Fiber Optics
- Indicator parameter screening
- Visual Observation

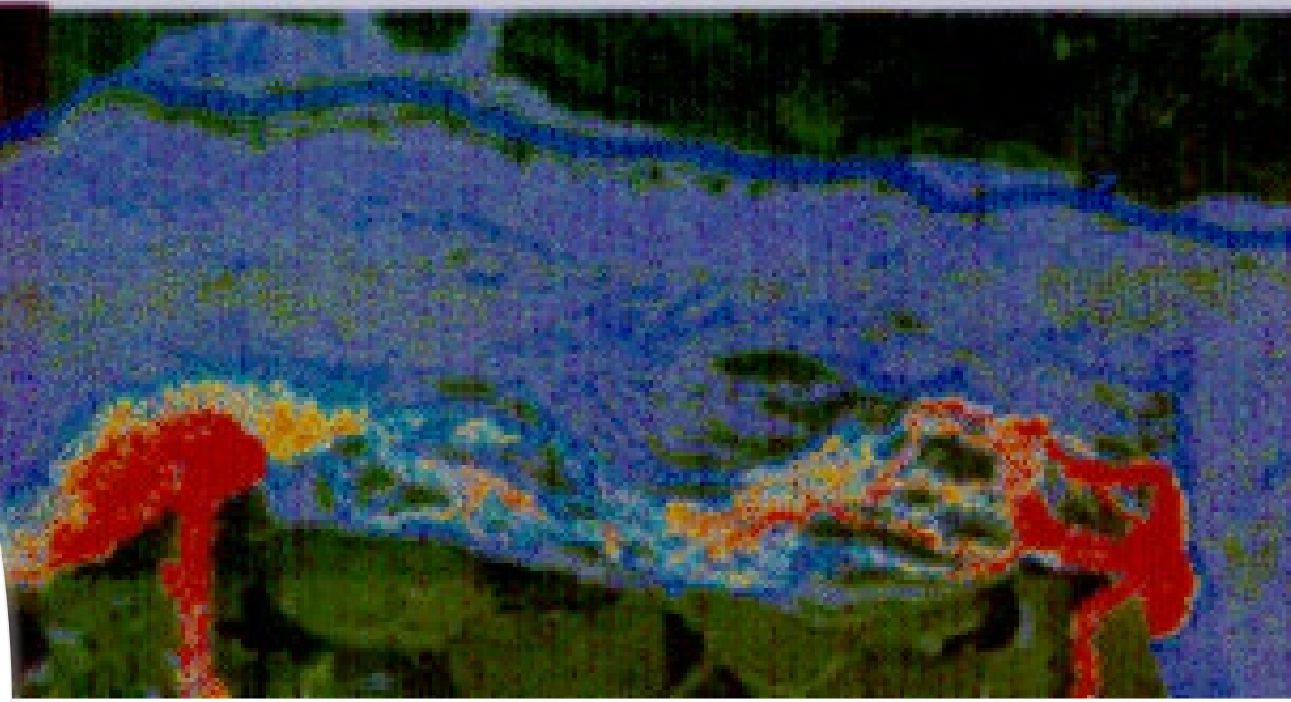
Mini-Piezometer

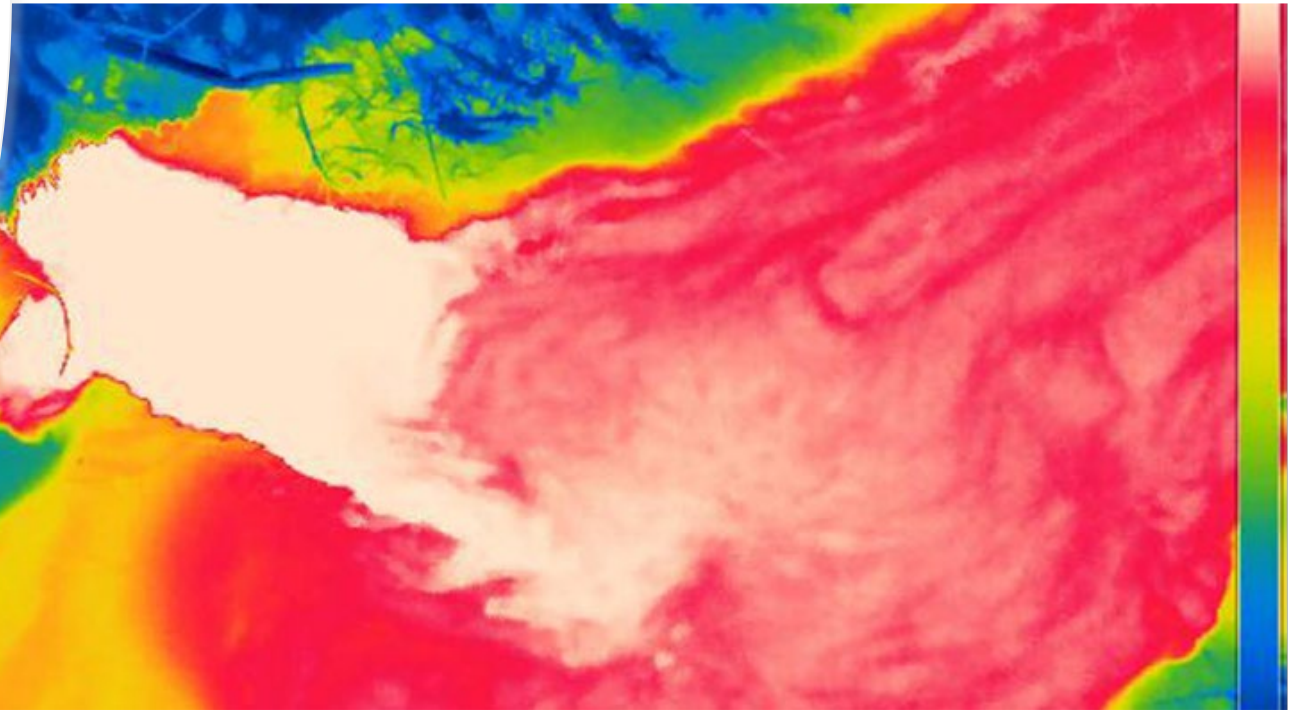
Indicates discharge/recharge

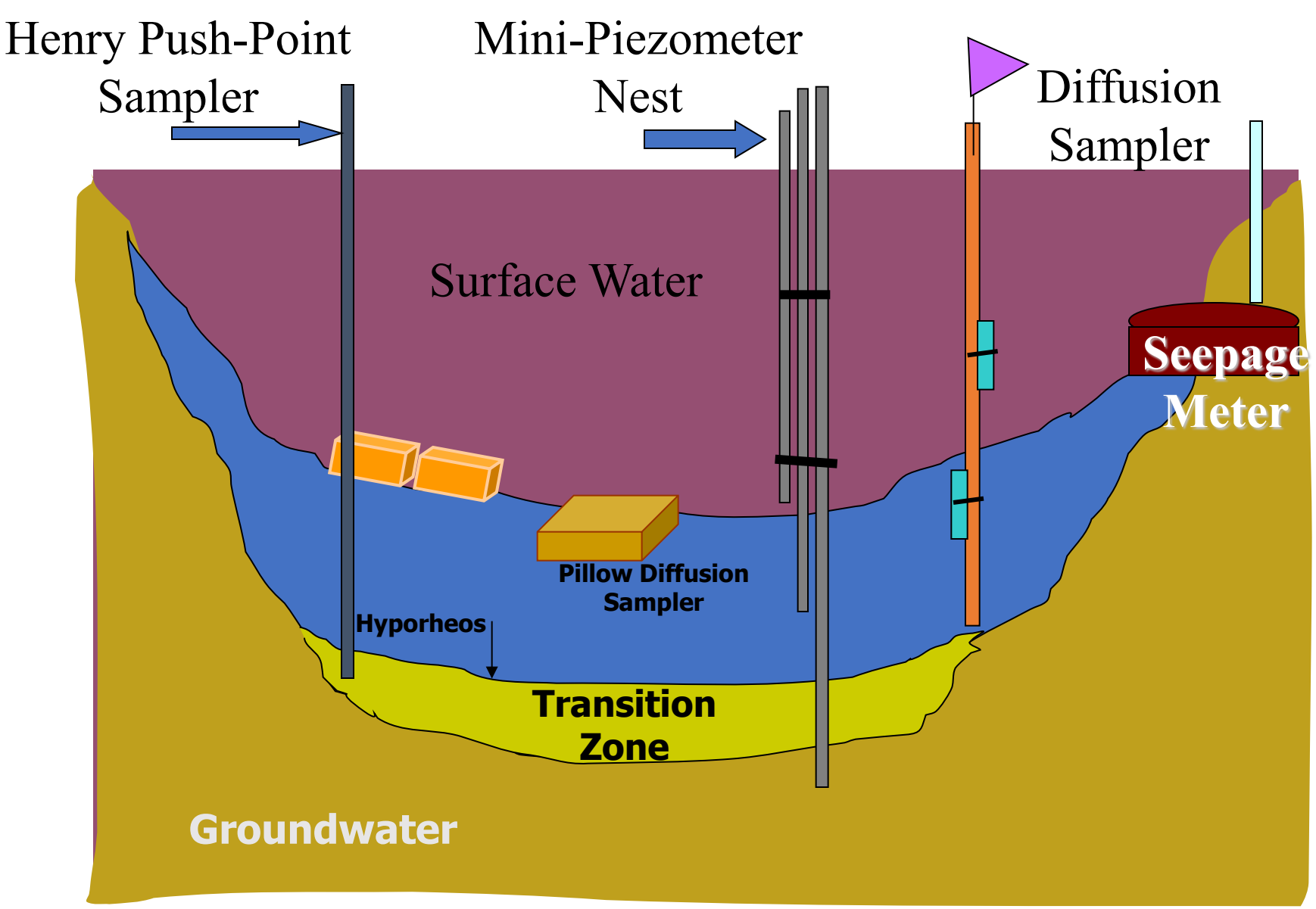
Can be used to estimate vertical hydraulic gradient and flow rate

Seepage Meter

Thermal Imaging






Henry Push-Point Sampler
Mini-Piezometer Nest
Diffusion Sampler
Surface Water
Seepage Meter
Pillow Diffusion Sampler
Hyporheos
Transition Zone
Groundwater

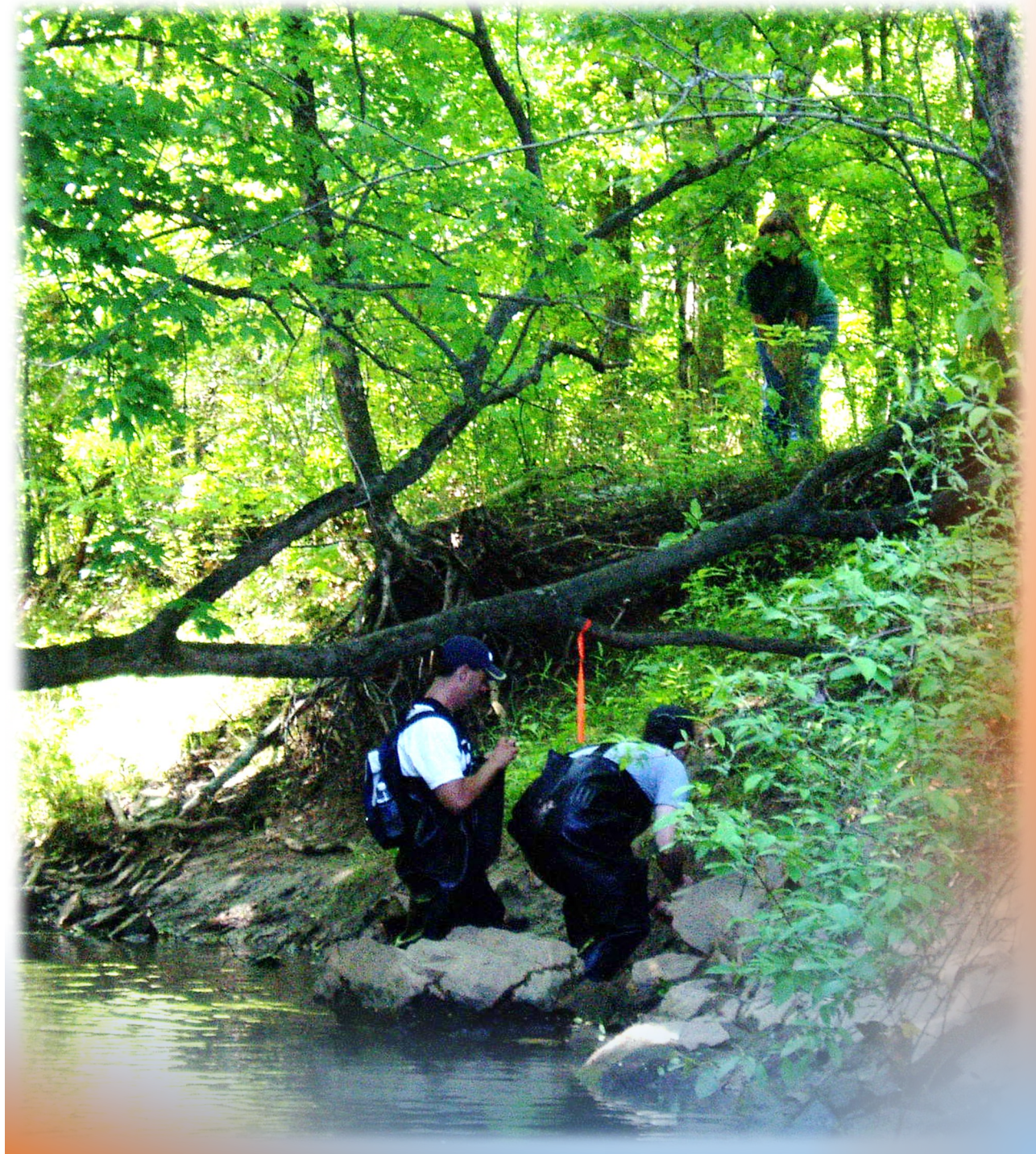
Vapor Diffusion Sampling

Making the Diffusion Sampler

Placing the Vapor Diffusion Sampler

Vapor Diffusion Sampler in Place

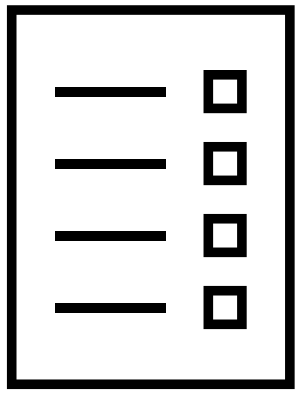
Looking for the Vapor Diffusion Sampler




Oops

Henry (MHE) Push Point Sampler

<100$
Reuseable



Let’s hear from you…
Please respond to the poll

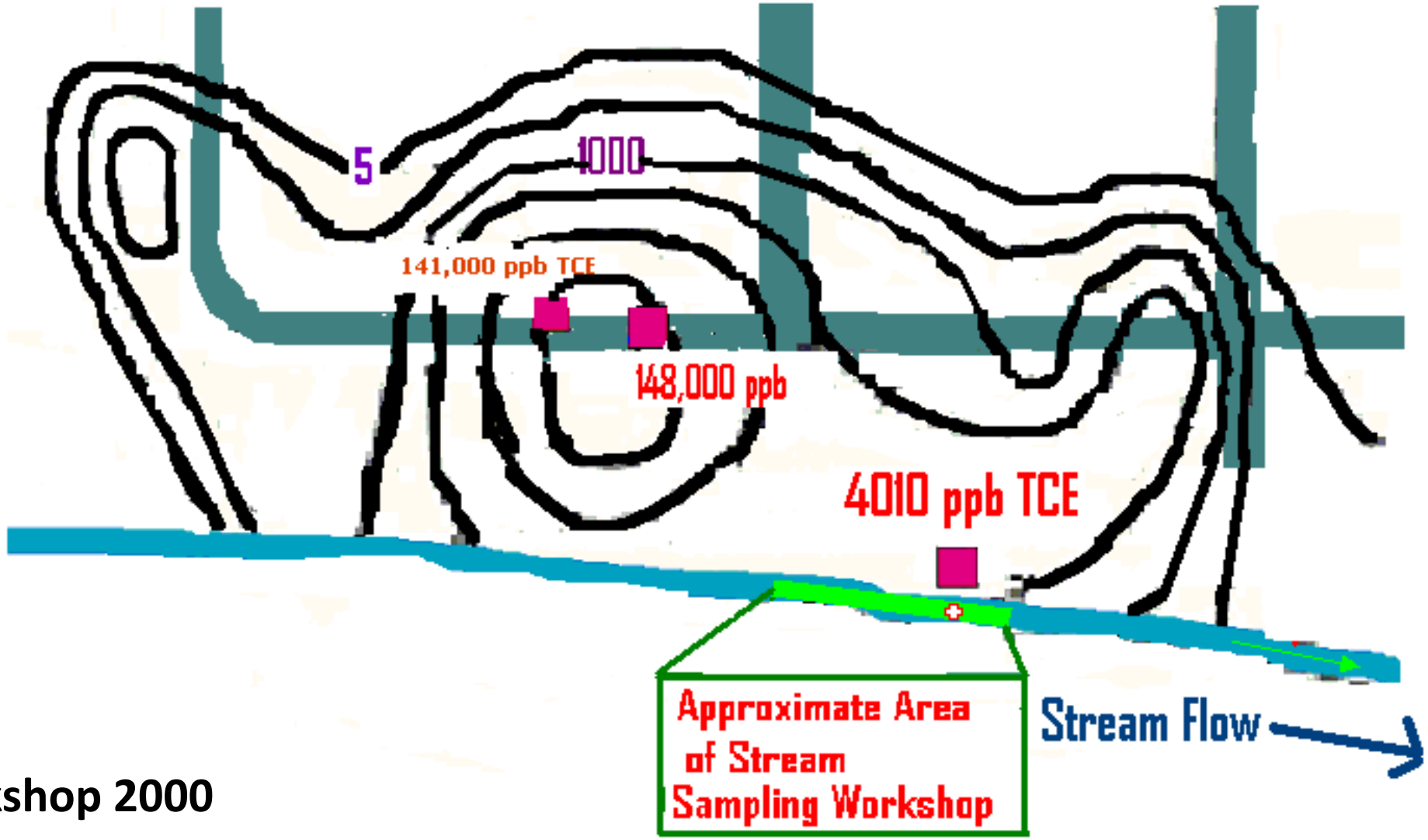
Have you used a push-point sampler to evaluate the transition zone?

- Yes
- No
- Unsure

Adhesive Manufacturing, SC

Groundwater Forum Meeting 2000

Field Demonstration of Henry Pushpoint, Diffusion Sampling



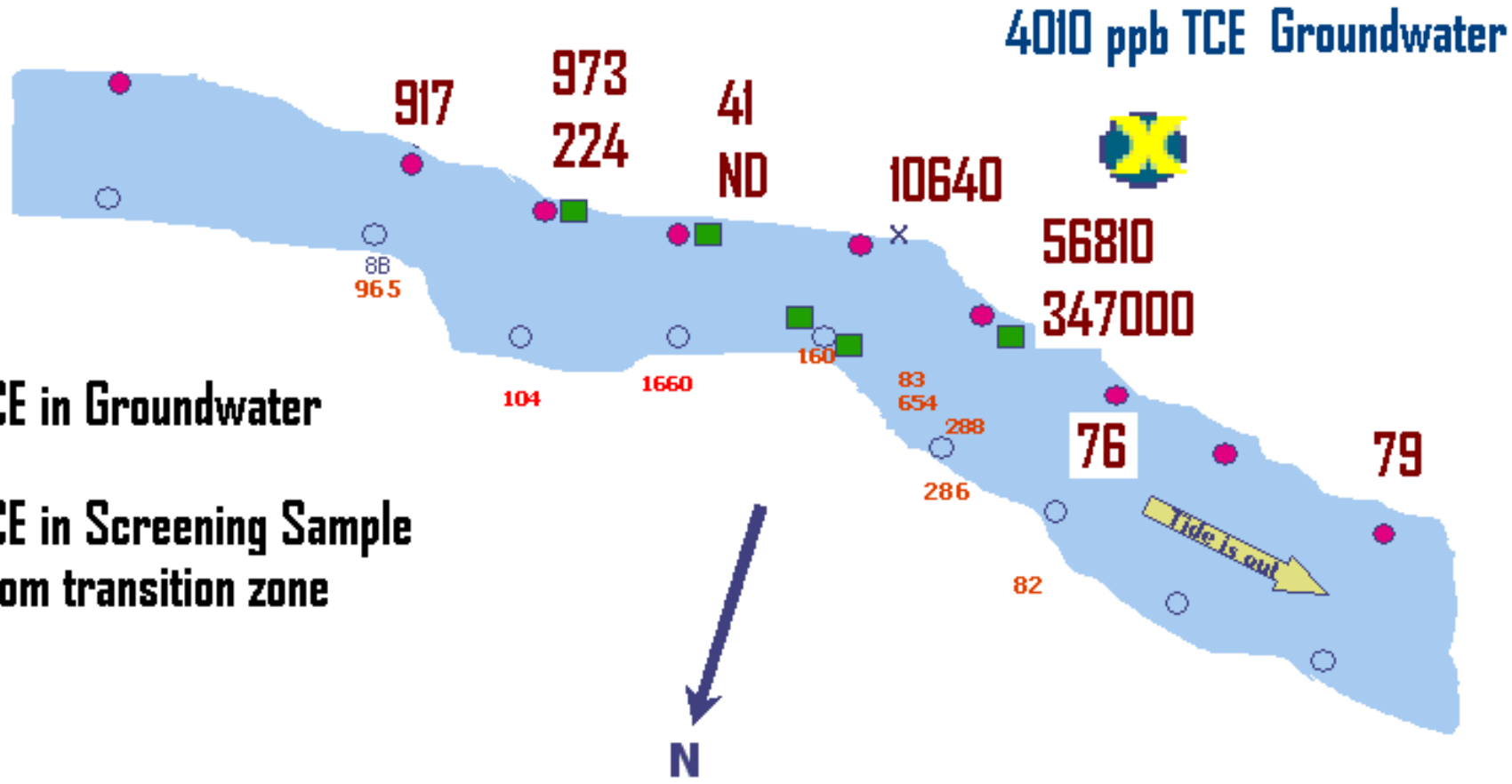
GWF Workshop 2000

TCE at Adhesive Manufacturer

148,000 ppb TCE Groundwater

Pushpoint Samples

Diffusion Samples

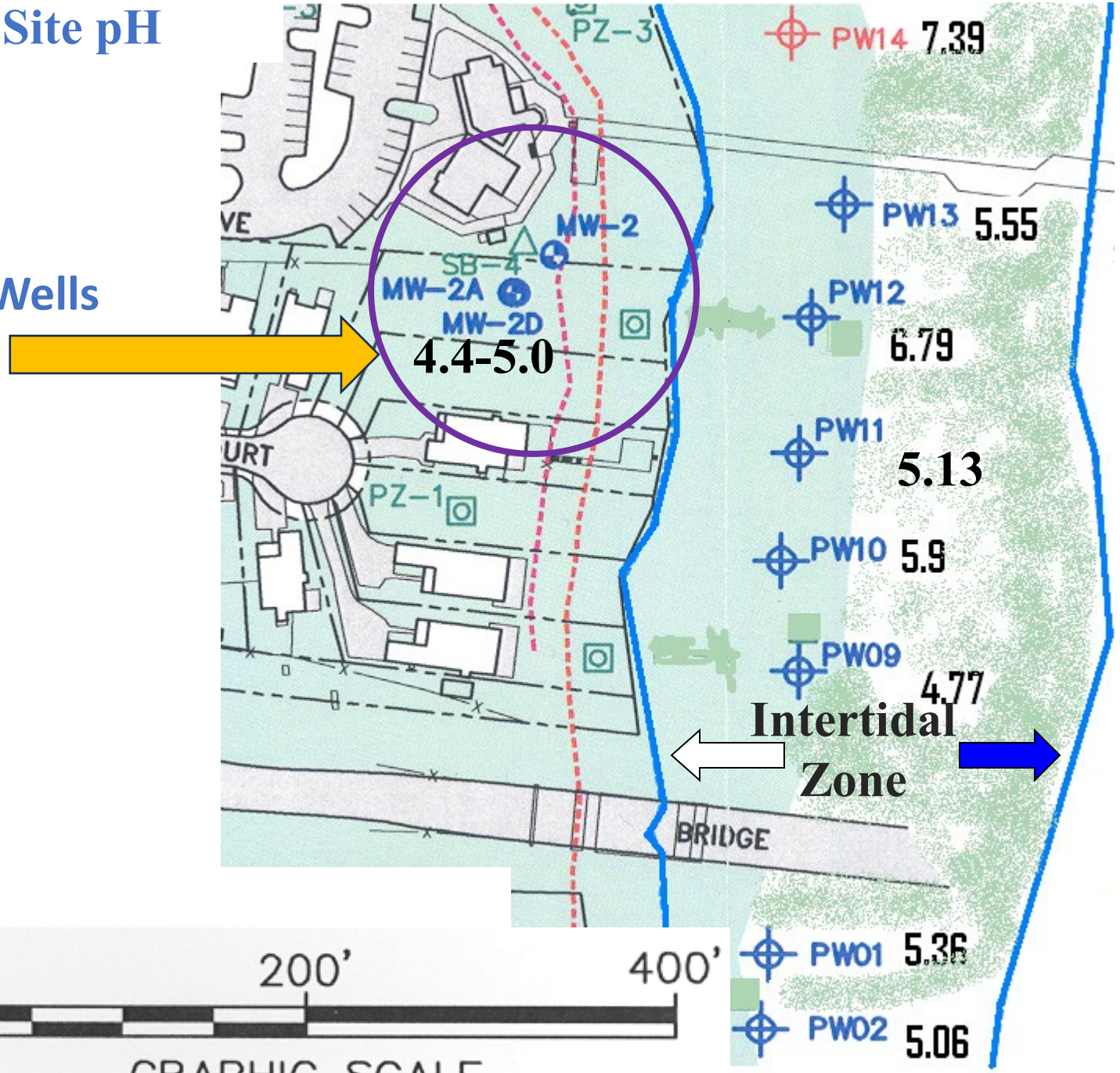


Low Country Fertilizer Site, R4 Case Study

- Push-Point Sampling
- Heterogeneity
- Indicator Parameters

Fertilizer Site pH

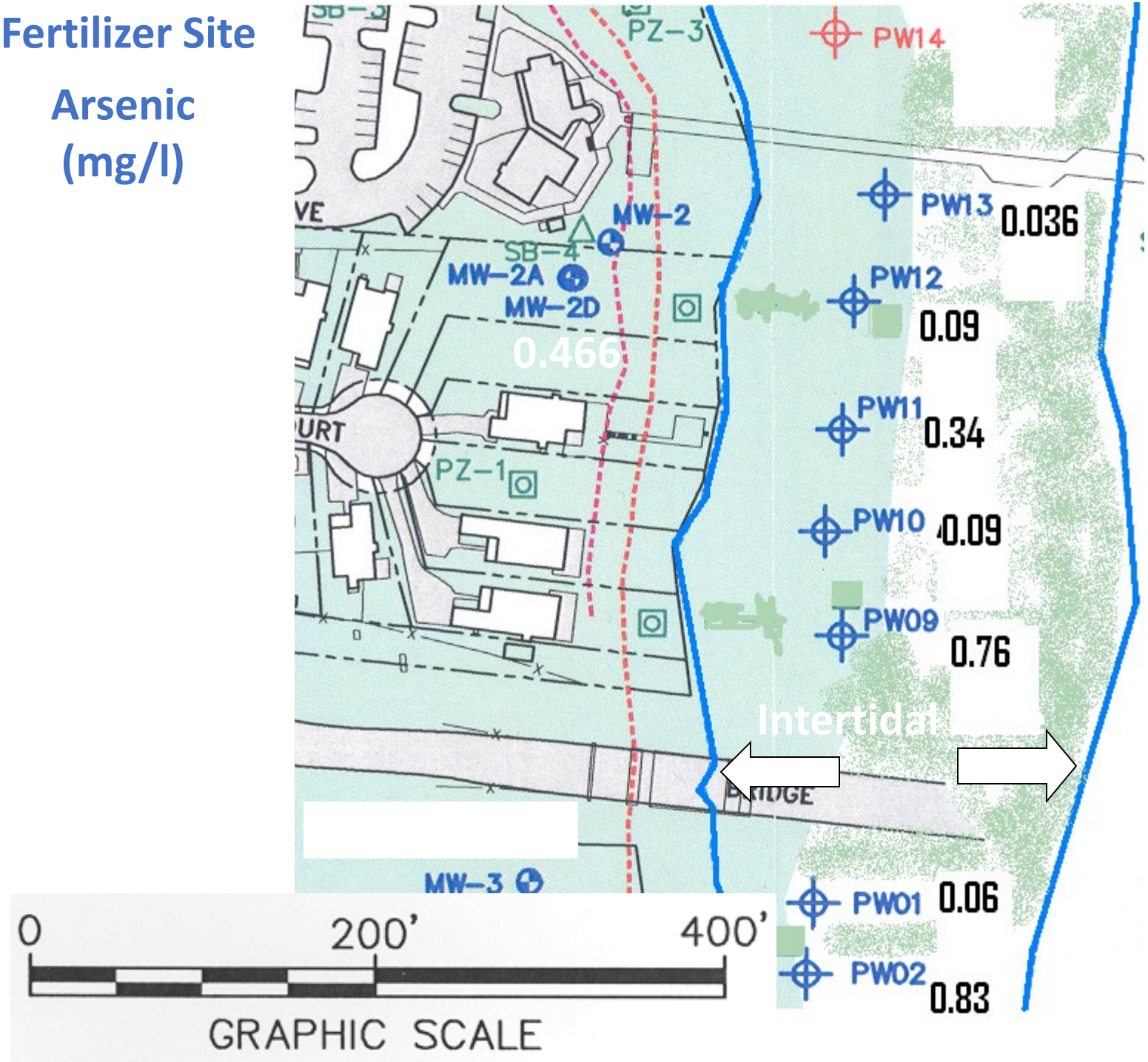
Monitoring Wells



River

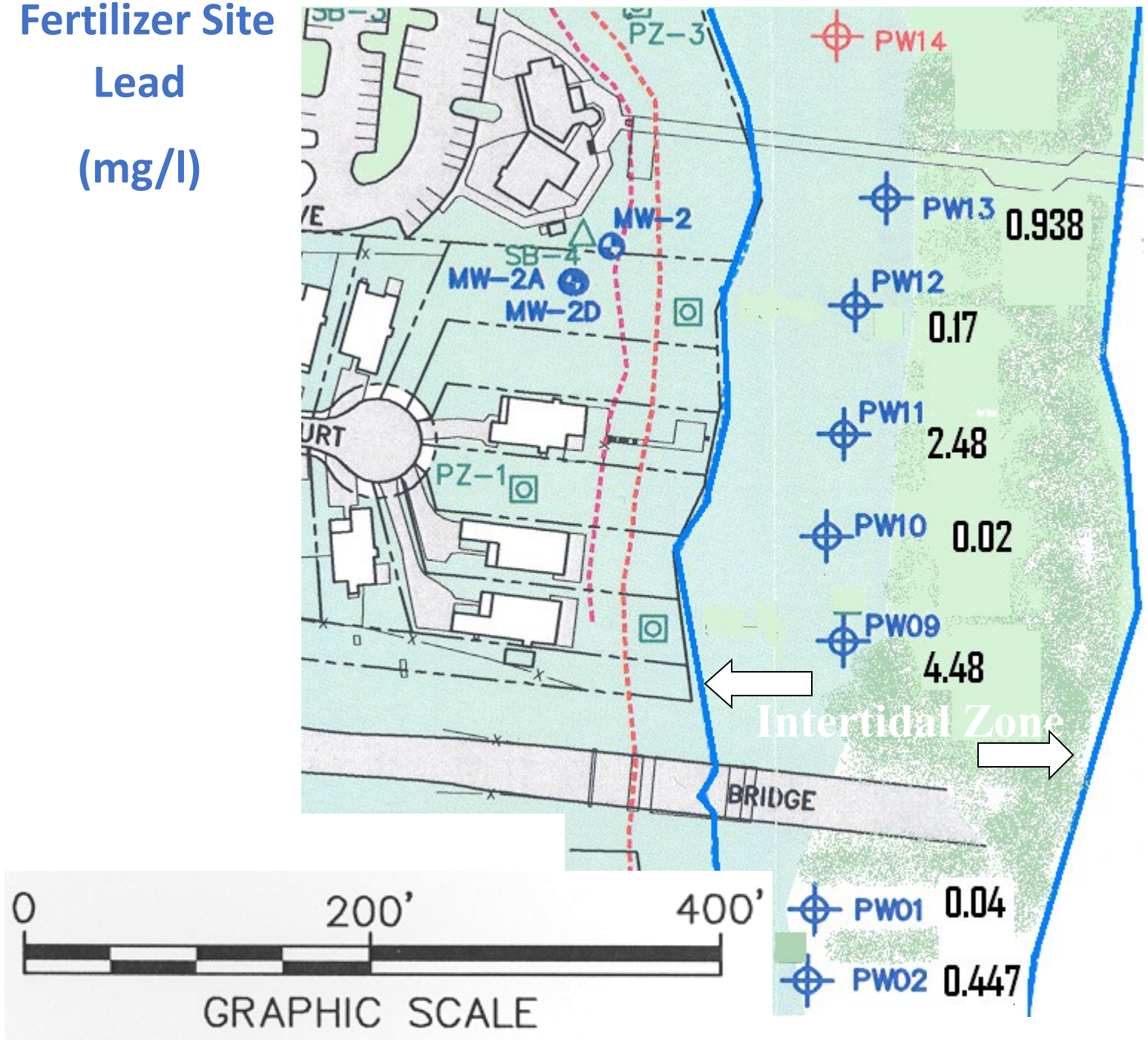
Fertilizer Site

Arsenic (mg/l)

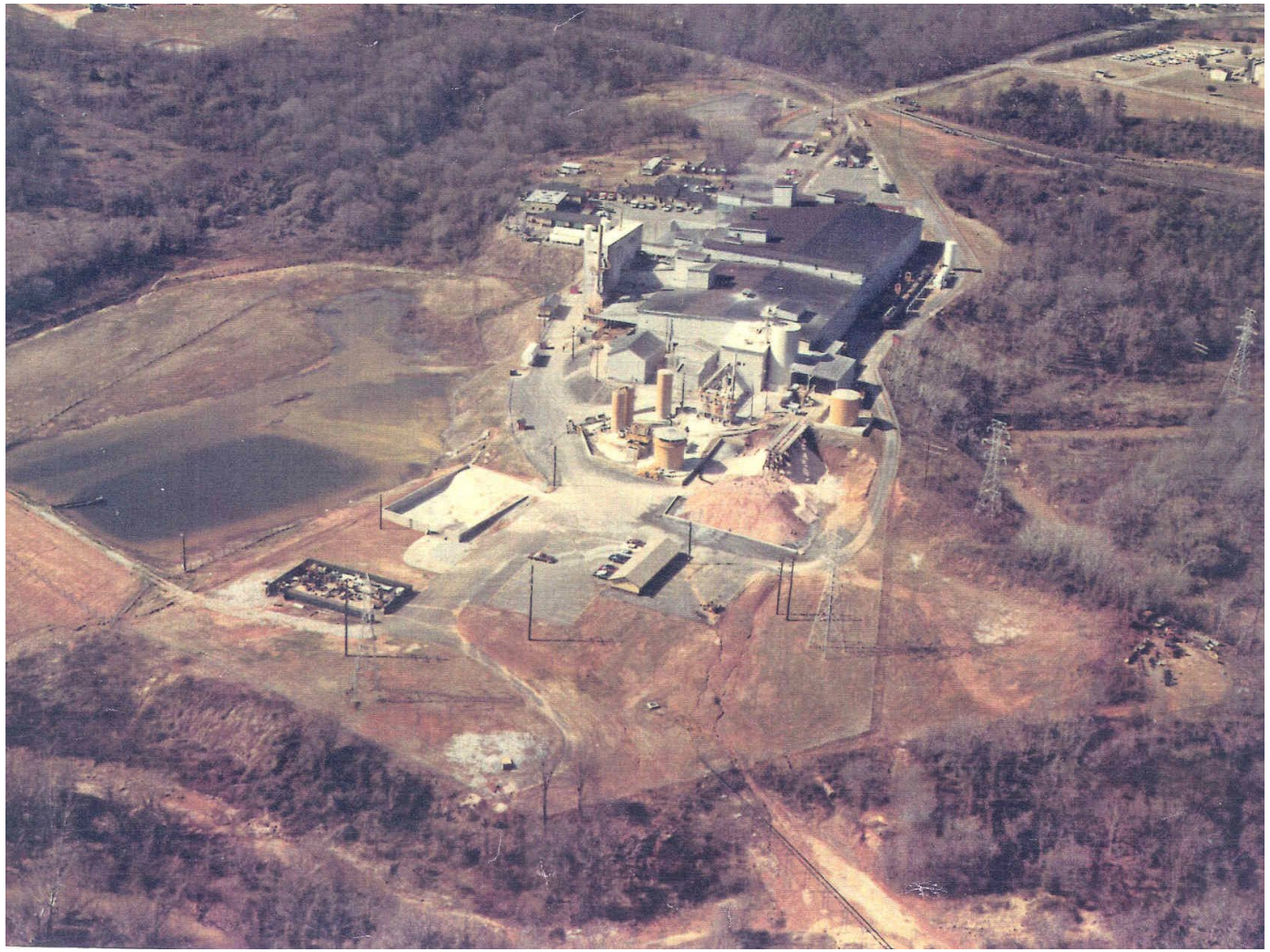


River

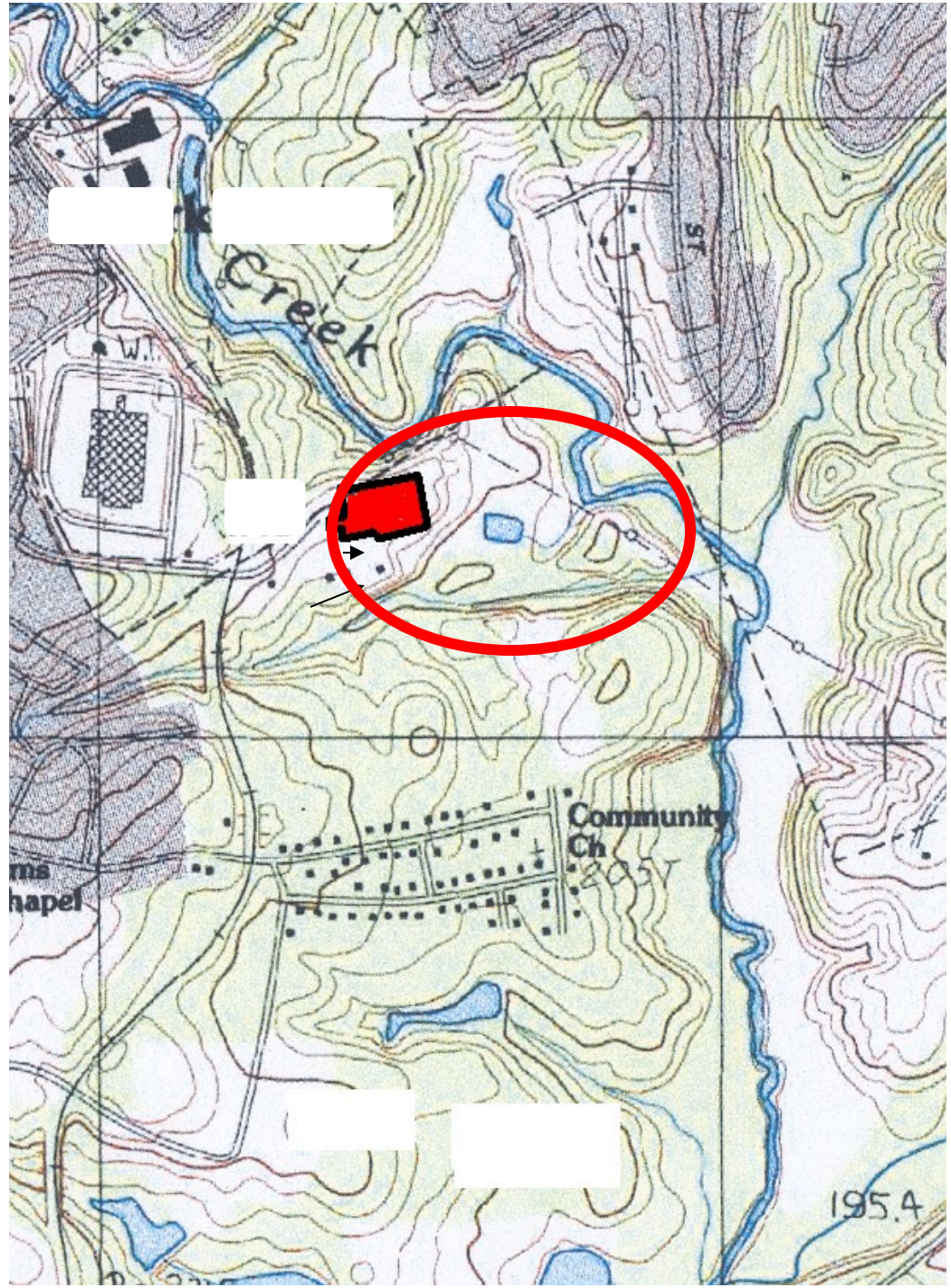
Fertilizer Site Lead (mg/l)



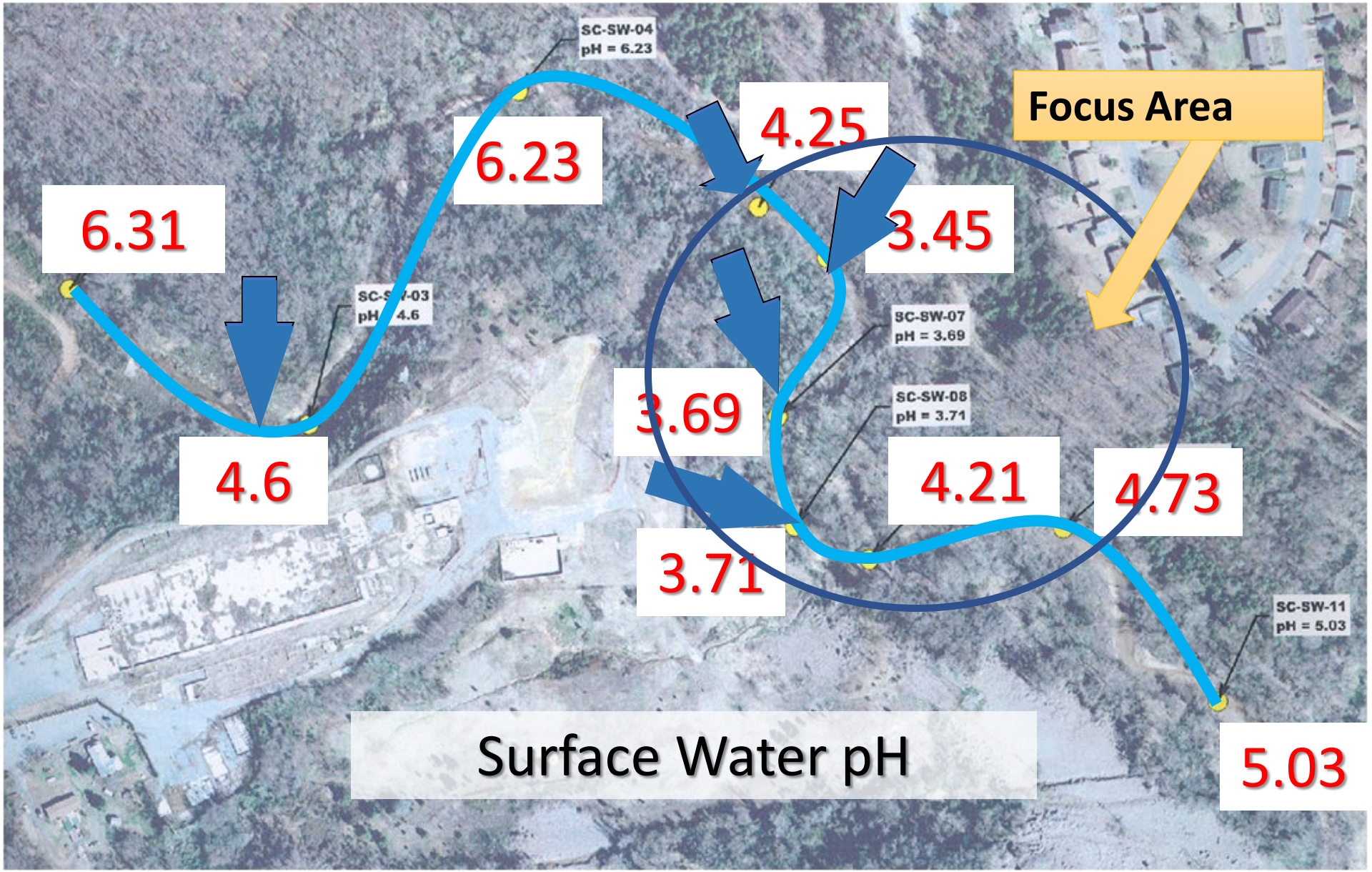
Upstate Fertilizer Site, R4 Case Study

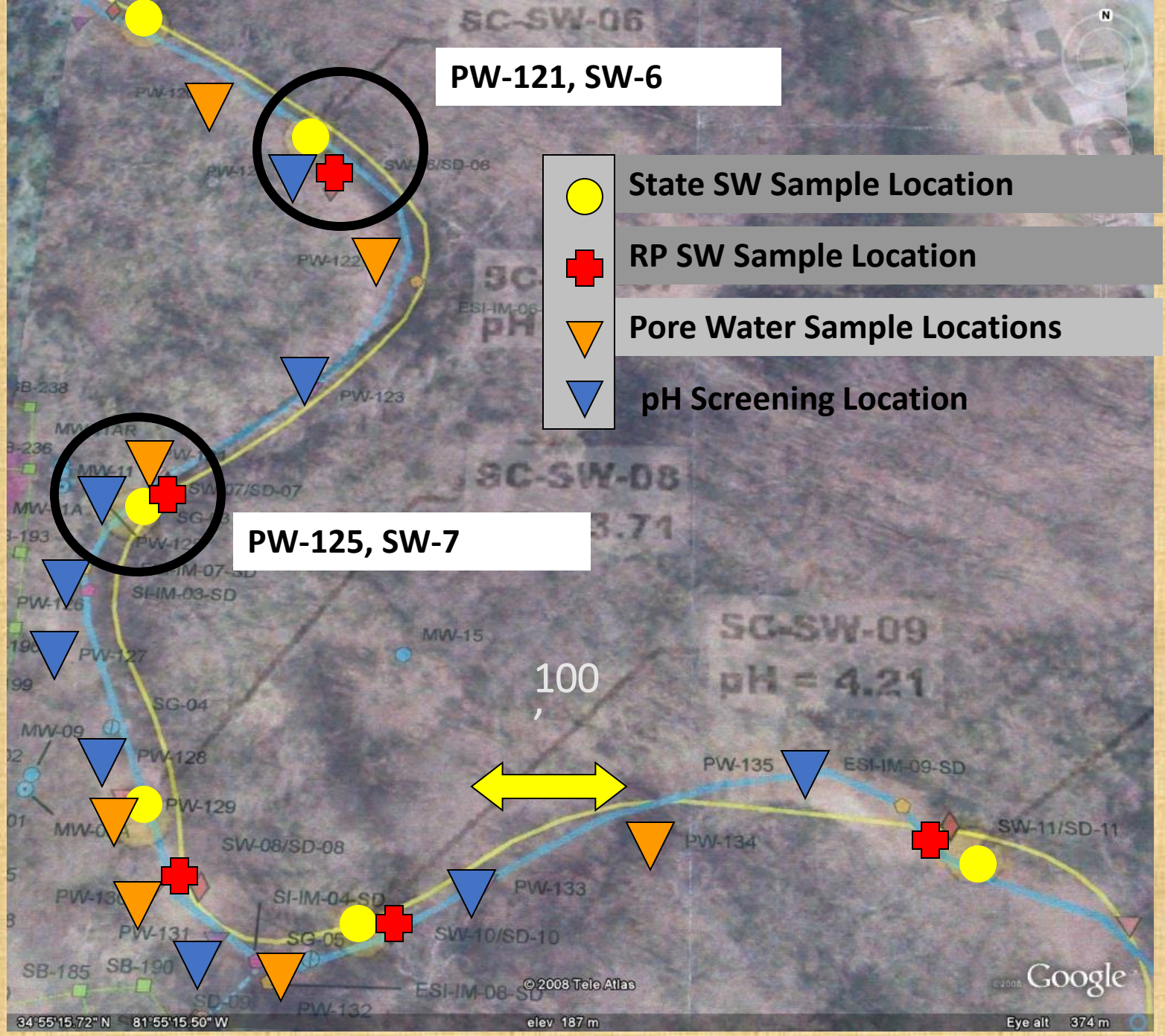


Indicator Parameters, Pore Water Sampling, Groundwater Sampling, Surface Water Sampling


Creek
W.T.
ST
Community
Ch
hapel
195.4

Areas of Suspected Contaminated Groundwater Discharge




PW-121, SW-6
State SW Sample Location
RP SW Sample Location
Pore Water Sample Locations
pH Screening Location
PW-125, SW-7
100
SC-SW-06
SC-SW-08
SC-SW-09
pH = 4.21
PW-121
PW-122
PW-123
PW-125
PW-126
PW-127
PW-128
PW-129
PW-130
PW-131
PW-132
PW-133
PW-134
PW-135
SW-06/SD-06
SW-07/SD-07
SW-08/SD-08
SW-10/SD-10
SW-11/SD-11
SI-IM-03-SD
SI-IM-04-SD
ESI-IM-08-SD
ESI-IM-09-SD
MW-09
MW-15
SG-04
SG-05
SB-185
SB-190
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Google
34°55'15.72" N 81°55'15.50" W
elev 187 m
Eye alt 374 m

Pore Water vs Surface Water, SW-06/PW-121

Parameter (ppb)	Pore Water	State SW	RP SW
pH	4.12	3.45	5.51
Al	220,000	41,000	430
Be	39	11	<1
Fluoride	190,000	34,000	390
Zn	2900	500	8.2
TNT	NA	20	NA

Pore Water vs Surface Water and Groundwater SW-07/PW-125/MW-11

Parameter (ppb)	MW-11	Pore Water	State SW	RP SW	
pH	3.56	4.03	3.69	5.31	
Al	160,000	120,000	66,000	480	
Be	35	22	14	<1	
Fluoride	170,000	130,000	380	420	
Zn	1100	1100	580	9.2	
Nickel	260	230	160	1.6	

Other Tools (Not Rudimentary)

- **Towed Probe**
- **Ecomapper**
- **Fiber Optics**
  (Region 8, Ian Bowen)

Questions we ask:

Groundwater/ Surface Water interactions

Is it possible to collect pore water samples at the site?

Where/when is ground water discharging to surface water?

Were surface water samples collected at locations of suspected ground water discharge and how were discharge locations identified?

Were surface water samples collected adjacent to the site? Bottom of water column?

Does seasonality affect GW/SW interactions?