

# Testing the relation between pre-sample purge extent, parameter stabilization and dissolved contaminant concentration at a DNAPL site



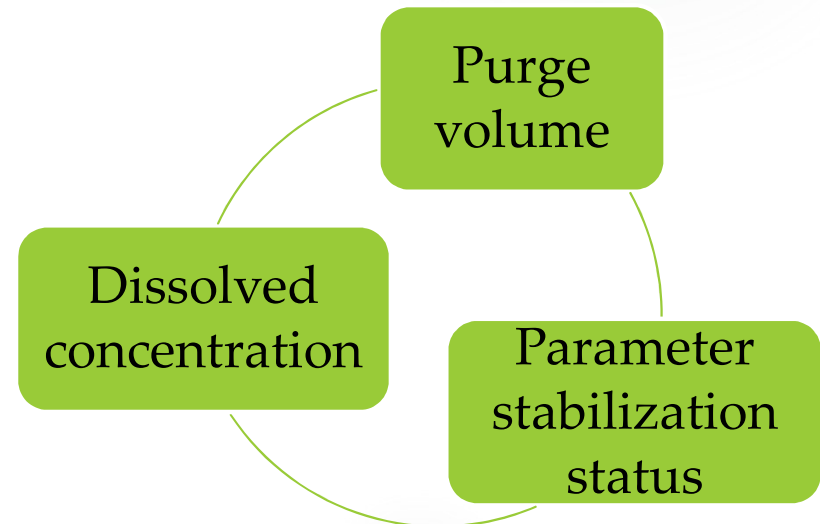
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# Background

## How to take representative groundwater sample from a monitoring well?

- ▶ Direct contact between groundwater and atmosphere
- ▶ Physicocemical processes – change water quality
- ▶ Purging is needed prior to sampling
- ▶ Regulations are not consequent



# Introduction

- ▶ Extent of purging?
  - ▶ **Purged well volumes:** from three-five to twenty volumes (*Herzog et al 1988*)
  - ▶ **Measuring field parameters** (pH, specific electric conductivity, temperature, dissolved oxygen, oxidation-reduction potential, turbidity) **stabilize**
  - ▶ Definition of parameter stabilization? Not uniform (*Gibbs et al 2000, McCarthy et al 1998, Barcelona and Helfrich 1986, EPA Region I Low Flow purging and sampling procedure rev. 2017, etc*)
  - ▶ Hungarian practice: purge until maximum three well volumes

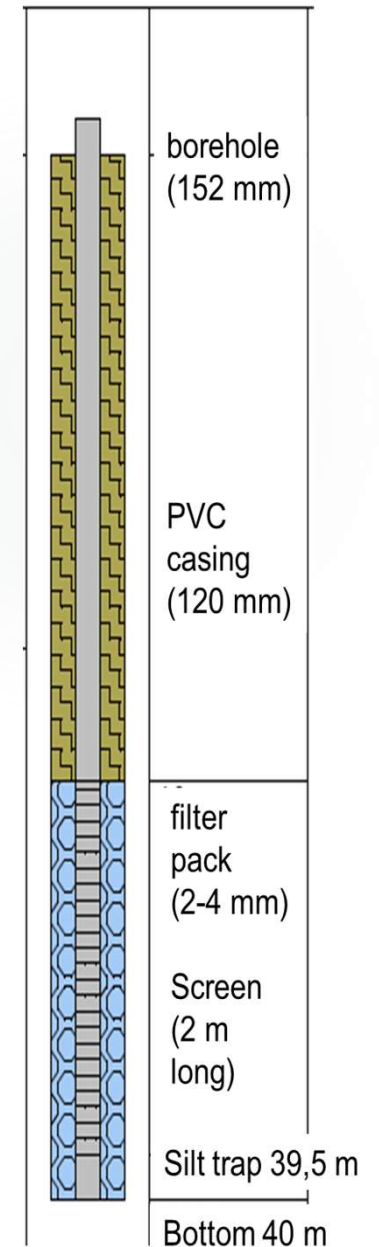
# *Method*

- ▶ Purging until parameter stabilization (pH, specific conductivity, oxidation-reduction potential) recorded at 5-3-1 minutes interval
- ▶ Parameter stabilization: when all parameters were unchanged for three consecutive minutes.
- ▶ Dissolved concentration changes are assessed taking samples at the beginning of purging (T0), after three (T3) extractions of well volumes and at parameter stabilization (TP).
- ▶ Triplicate samples
- ▶ Test is repeated 5 times

# Monitoring wells

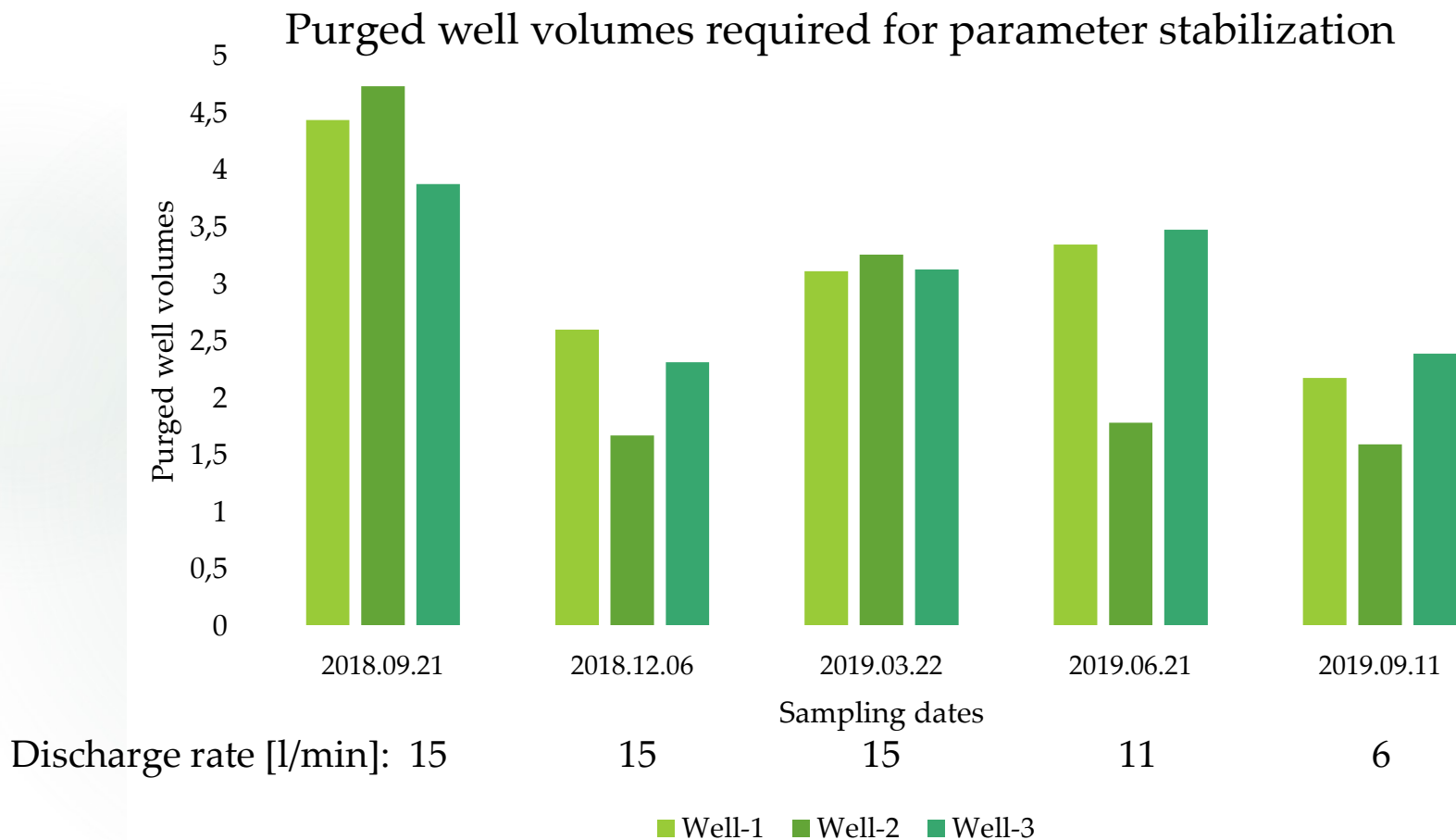
- ▶ Three wells at a chlorinated hydrocarbon contaminated site
- ▶ Well depth: 40 m
- ▶ Aquifer: fine sand

## Measuring field parameters in a flow-through cell



# Purge extent

- ▶ The extent of purging varied between 1,6 and 4,7 well volumes to parameter stabilization.



# Concentration changes

- ▶ The differences between three-well volume (T3) concentrations and parameter stabilization (TP) concentrations are not uniform

On the next slide:

- ▶ **T3 occurred before TP:** Concentration changes between **T3 and TP** [TP/T3 %]. The green ones mean that concentration decreased from T3 to TP, the red ones mean that concentration increased from T3 to TP
- ▶ **TP occurred before T3:** Concentration changes between **TP and T3** [T3/TP %]. The green ones mean that concentration decreased from TP to T3, the red ones mean that concentration increased from TP to T3
- ▶ changes were lower/higher than estimated maximum laboratory uncertainty

# Concentration changes

	Concentration changes between T3 and TP [TP/T3 %]			Concentration changes between TP and T3 [T3/TP %]		
	Well 1	Well 2	Well 3	Well 1	Well 2	Well 3
	21.09.2018.			16.12.2018.		
1,1-DCE	97%	94%	100%	97%	113%	100%
cis-DCE	99%	92%	102%	101%	100%	98%
tr-DCE	99%	91%	101%	99%	104%	101%
1,1-DCA	100%	100%	100%	100%	100%	100%
1,2-DCA	104%	83%	150%	100%	80%	87%
TCE	91%	88%	108%	106%	81%	120%
1,1,2-TCA	100%	100%	104%	100%	100%	58%
1,1,2,2-TCA	100%	100%	100%	100%	100%	100%
Vinyl chloride	101%	82%	102%	92%	70%	80%
	22.03.2019.			11.09.2019		
1,1-DCE	99%	71%	100%	33%	93%	100%
cis-DCE	106%	108%	93%	43%	103%	83%
tr-DCE	99%	108%	95%	39%	107%	82%
1,1-DCA	100%	100%	100%	68%	100%	100%
1,2-DCA	110%	58%	100%	75%	100%	100%
TCE	114%	93%	102%	64%	142%	111%
1,1,2-TCA	100%	100%	126%	100%	100%	101%
1,1,2,2-TCA	100%	100%	100%	100%	246%	100%
Vinyl chloride	104%	92%	92%	42%	67%	83%
	21.06.2019.			21.06.2019.		
1,1-DCE	103%		100%		76%	
cis-DCE	144%		109%		105%	
tr-DCE	98%		113%		106%	
1,1-DCA	105%		100%		100%	
1,2-DCA	120%		100%		82%	
TCE	100%		135%		100%	
1,1,2-TCA	100%		92%		100%	
1,1,2,2-TCA	100%		100%		100%	
Vinyl chloride	120%		102%		67%	



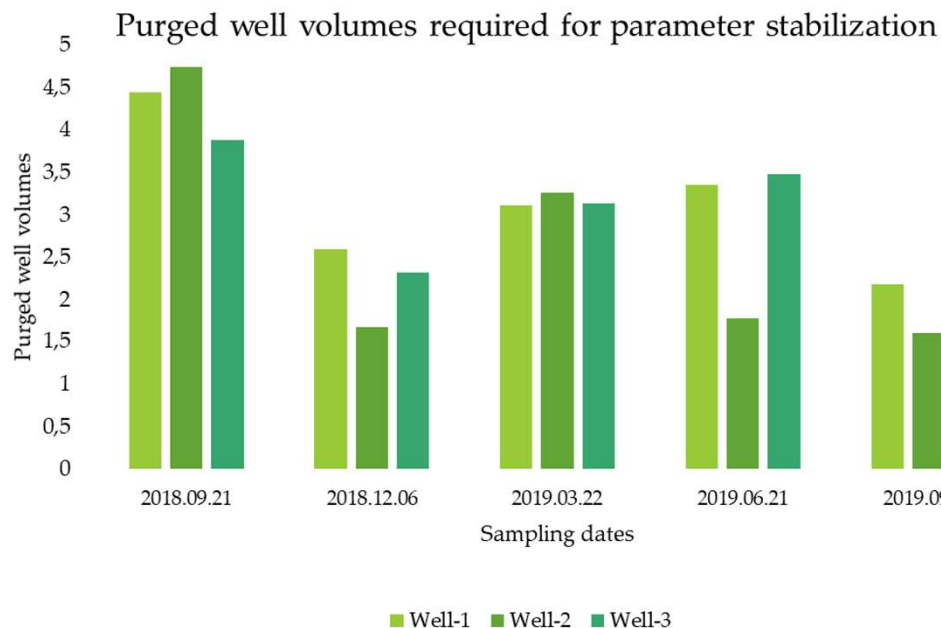
# *Concentration changes*

- ▶ Concentration behaviour seems to be different for cases when TP occurs prior to T3 and vice versa
- ▶ When TP precedes T3 concentrations are not changing or in case of significant changes dominantly increasing
- ▶ When T3 precedes TP concentrations dominantly decreasing or not changing significantly

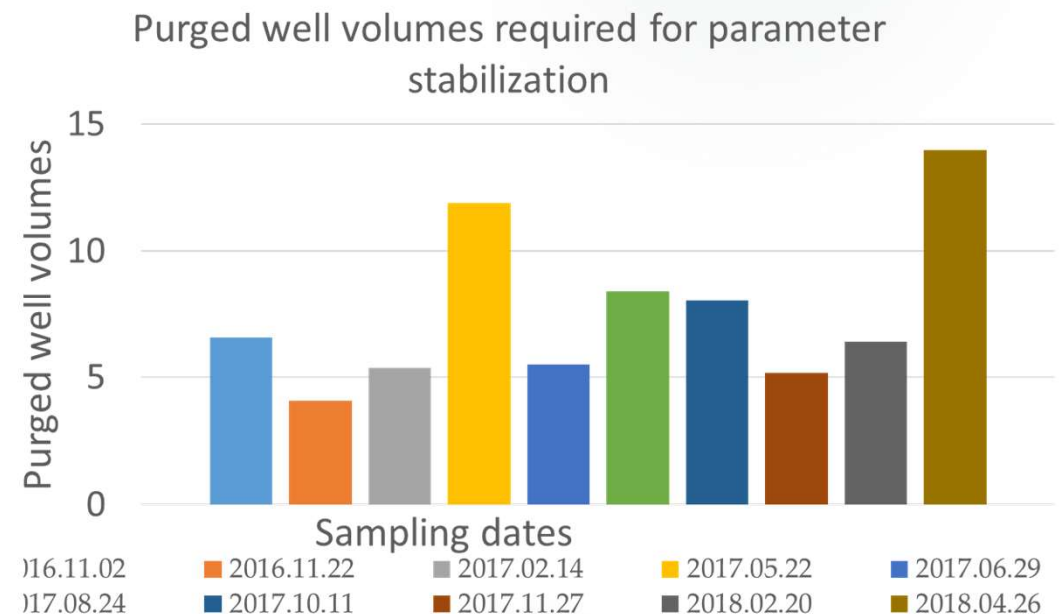
# Preliminary results

- ▶ Less purged well volume (1,6-4,7) to reach parameter stabilization (comparing with one of our previous investigations at a kerosene contaminated site with shallow wells – 4-14 well volume)

## Chlorinated hydrocarbon contaminated site



## Kerosene contaminated site



# Conclusions

- ▶ Current regulations do not distinguish between differently constructed wells, meanwhile there is a clear difference in the purge behavior
- ▶ Application of current regulations do not ensure representative samples
- ▶ Well volume based definition of purge extent may not be always the right approach depending on well construction
- ▶ Current parameter stabilization criteria needs to be improved

# Thank you!



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