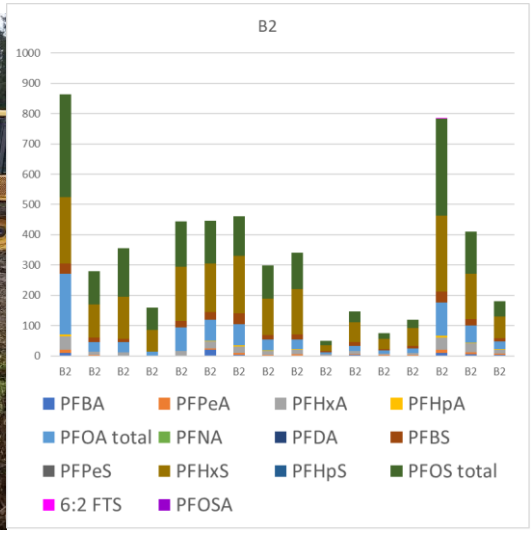
Lessons learnt from a field trial of colloidal activated carbon injection to reduce PFAS migration from a contaminated site



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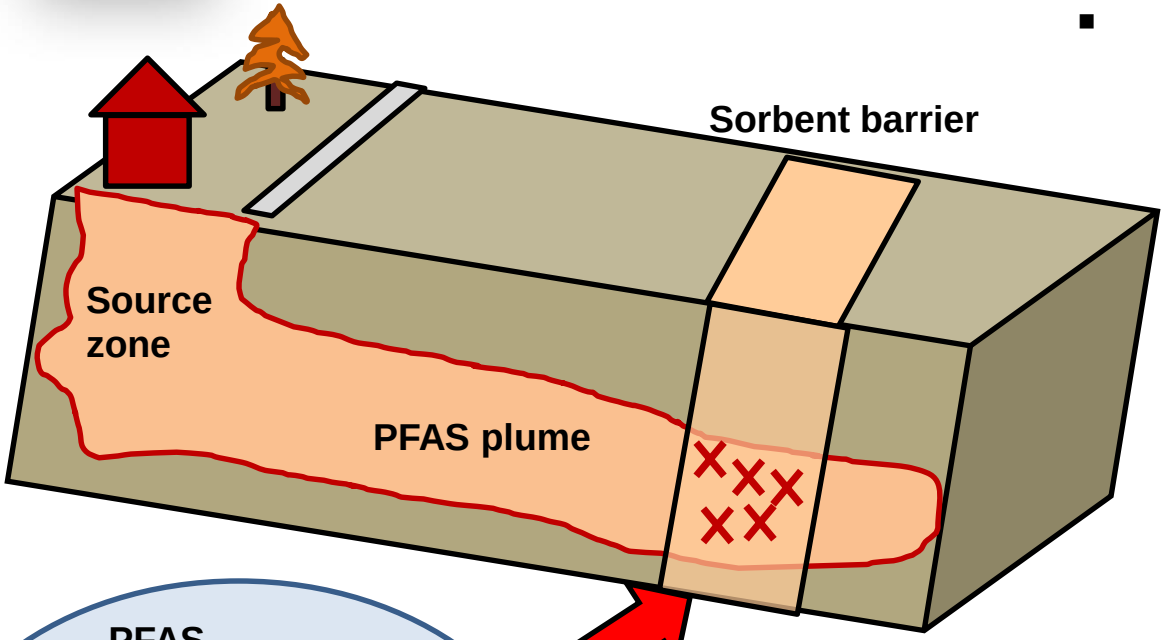
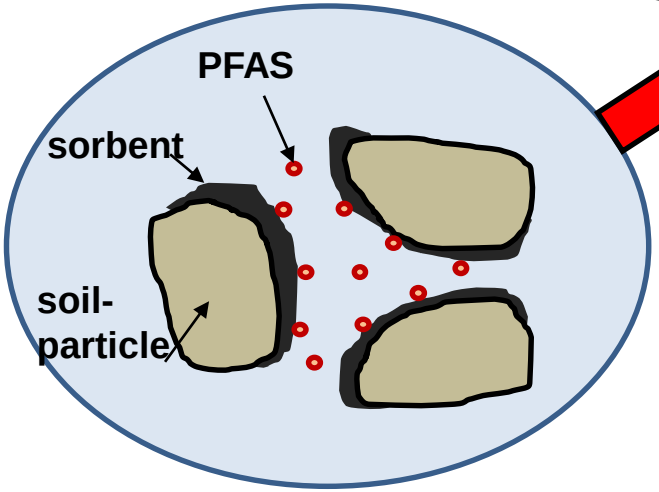
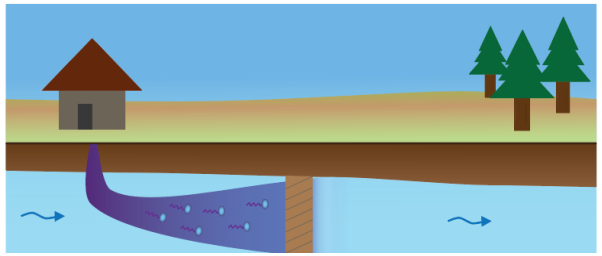
Sorbents for PFAS mitigation

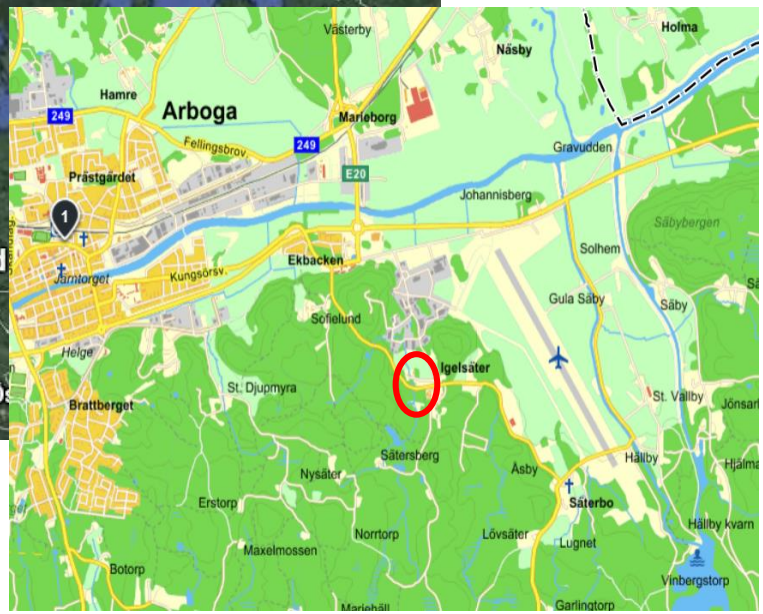






- **Sorbents are applied in a remediation zone**
  - Stops further migration of PFASs
  - PFASs are collected and concentrated in a small area
  - Methods for regenerating the sorption zone are also evaluated
  - To catch all or most of the PFASs in the groundwater is a challenge

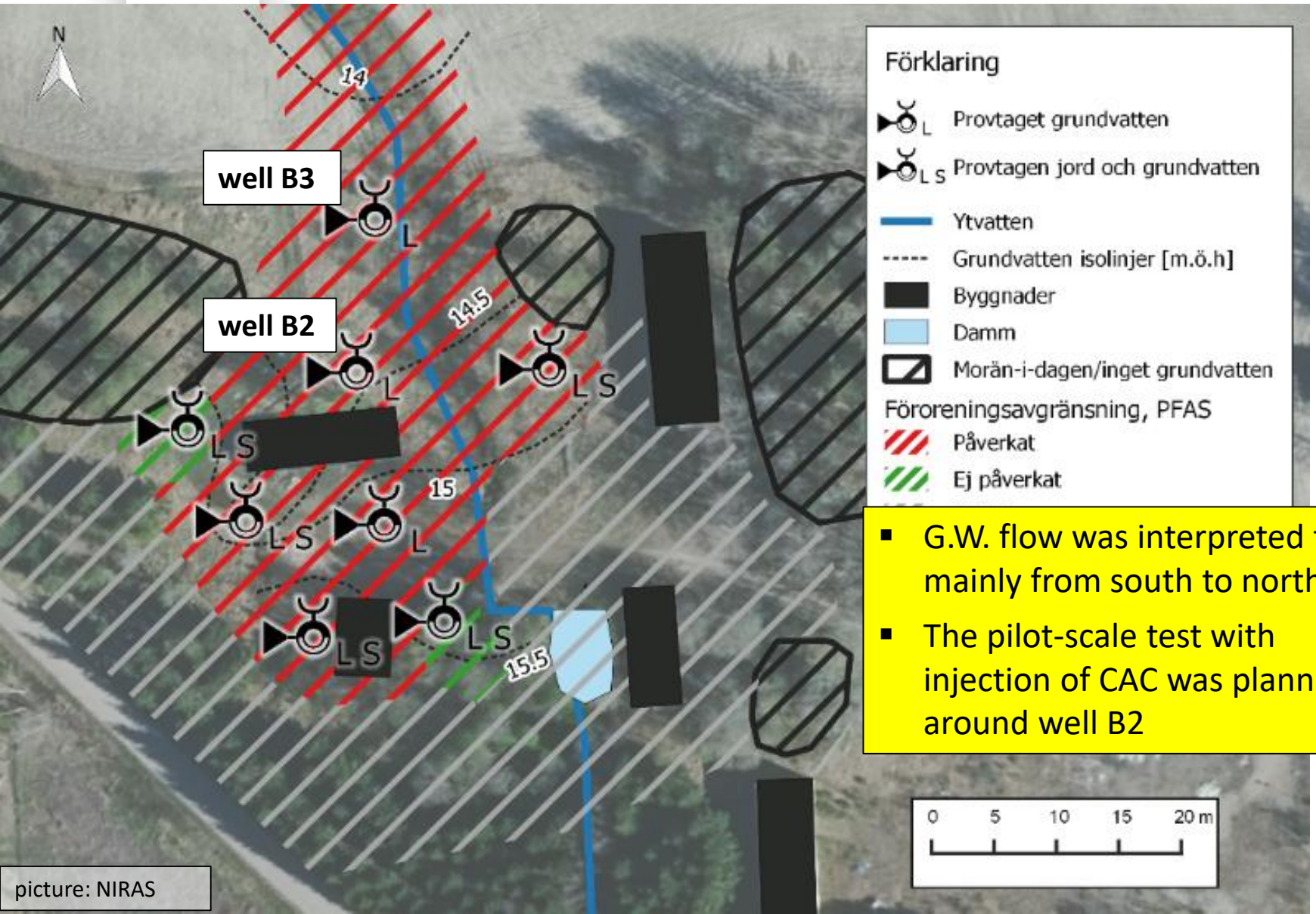
Sorbent injection at Arboga



- Field site: **Centrala Flygverkstaden Arboga (CFA) -** manufacturing & repair of airplanes for the Swedish airforce
- **PFAS**-contaminated **fire-fighting** training site
  - Sorbents in the form of **Colloidal Acitvated Carbon** (CAC) (Plumestop®) were injected in a field trial to reduce PFAS transport with groundwater

Bild: Regenesis

Original interpretation of the PFAS plume



- G.W. flow was interpreted to be mainly from south to north
- The pilot-scale test with injection of CAC was planned around well B2

picture: NIRAS

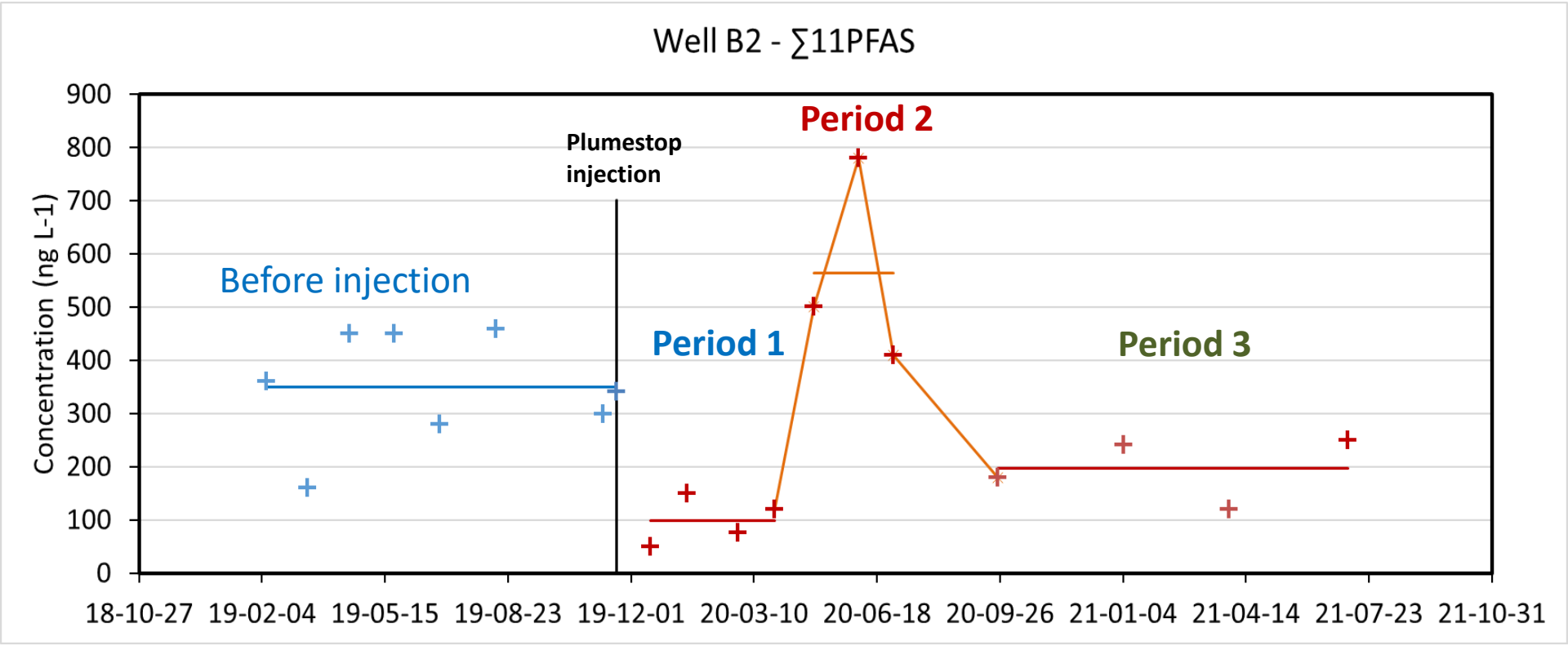
Injection of CAC, November 2019

stream

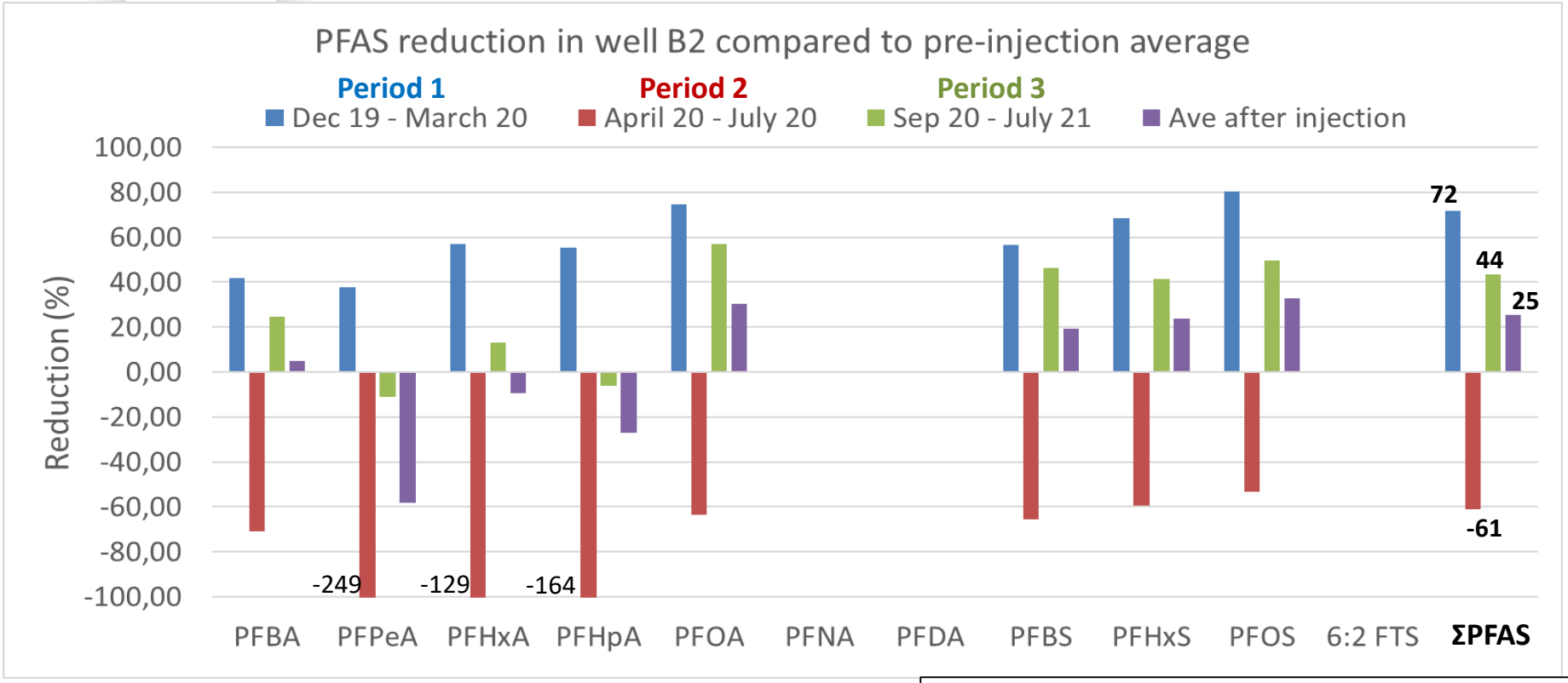
- Some problems due to CAC going into the stream
- $CaCl_2$ was injected to stabilize the CAC

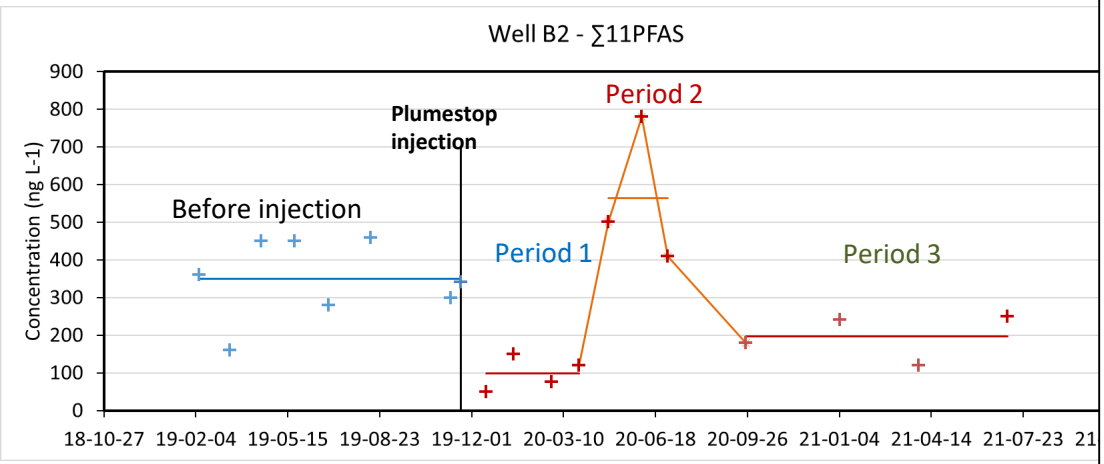
Results on PFAS conc. of the CAC injection

- Directly after the CAC injection there was a decrease in the conc. of the sum of 11 PFAS in well B2 (**period 1**)
- Then there was a strong pulse-like increase (**period 2**)
- Finally, concentrations were again relatively stable at levels lower than pre-injection (**period 3**)

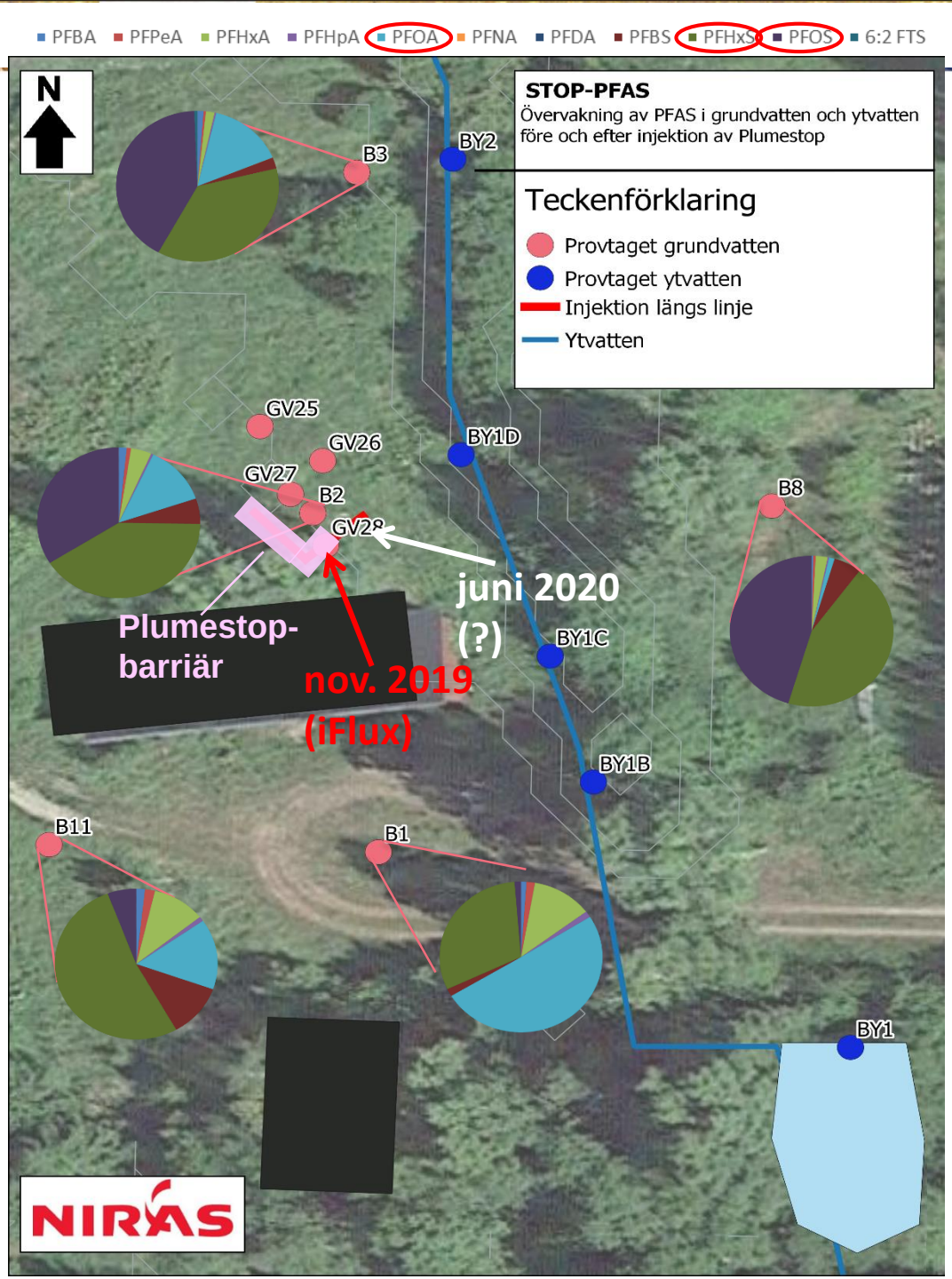


PFAS reduction in B2





- Initially (**period 1**) there was reduction in all PFASs, 72% for Σ11PFAS
  - The reduction depends on carbon chain length
- In **period 2** all PFASs increase (negative reduction)
- Reduction after rebound (**period 3**) is less than initially (44%)
- **Average** (p. 1, 2, 3) reduction is 25%



- The barrier became shorter than planned because of injection problems when CAC migrated into the stream
- The composition of PFASs in well B2 indicate influence from both the source to the South and to the East
- A probable explanation to the later increase in PFAS conc. in B2 is that the flow shifted to coming more from the East leading to bypass of the CAC barrier

Reflections & conclusions

- The CAC barrier used here was a pilot scale test upstream a single well => the barrier was not designed to intercept the PFAS plume in an optimal way, but rather to perform a test on a small part of the plume. This proved to be difficult to do and probably reduced the amount of PFAS sorption compared to a full-scale design.
- A critical aspect using CAC is to distribute it in such way that it catches as much as possible of the dissolved contaminant plume – this is complicated by complex hydrogeological conditions
  - Thorough characterization and good knowledge about hydrogeological conditions, groundwater flow patterns and zones of preferential flow are critical to successful implementation
  - The zone of sorption must be designed and placed to optimally intercept the plume (regardless of seasonal changes in flow directions)
  - Complete elimination of PFAS migration with the groundwater was not achieved in this test.

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Thank you!

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