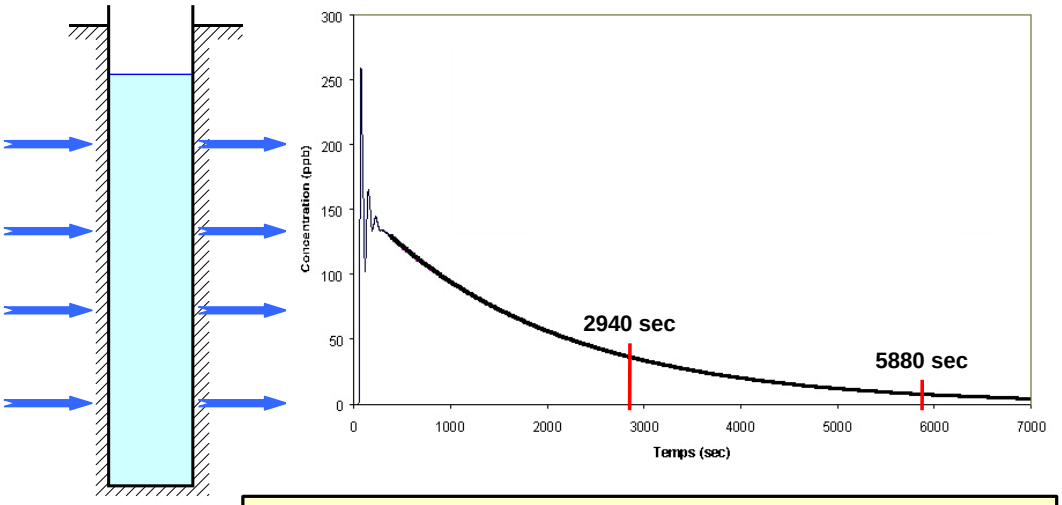
RENEWAL OF WATER IN A BOREHOLE

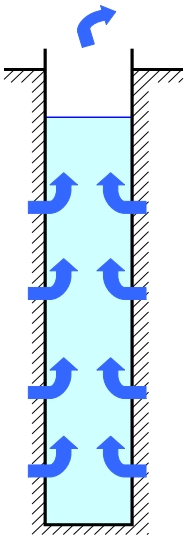


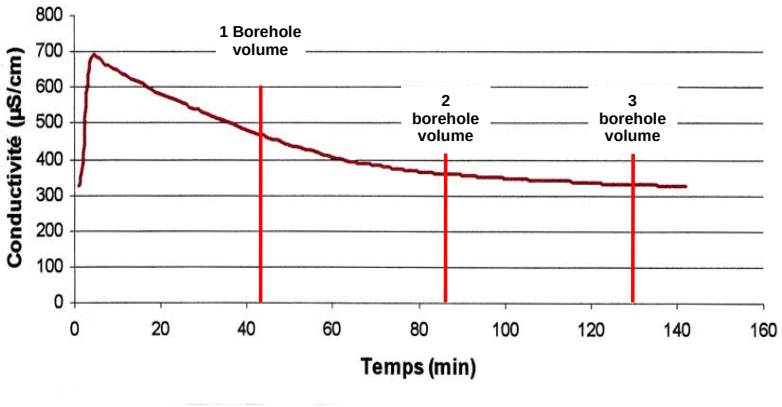
DISAPPEARANCE OF TRACER IN A BOREHOLE DRILLED IN FLOWING GROUNDWATER

The flow of aquifer renew progressively the water contained in the borehole and drained the tracer downstream.

The water in the aquifer takes 2940 s to flow of a distance equivalent to the borehole diameter: the experience shows that it is necessary to renew a minimum of 2 volumes of the water contained in the borehole to have the disappearance of the tracer

RENEWAL OF WATER IN A BOREHOLE





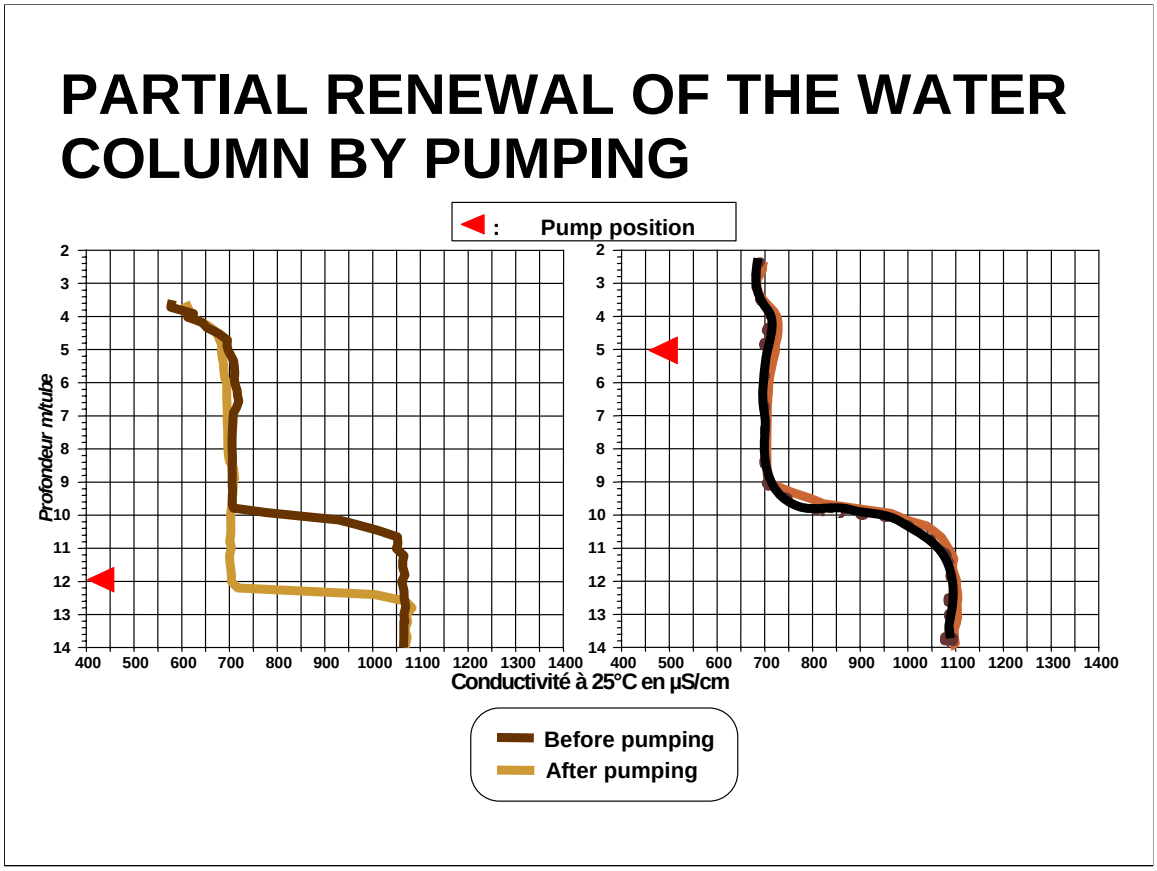
PUMPING (PURGING) TO ELIMINATE TRACER INTRODUCED IN A BOREHOLE

Pilot of university of Pau : filter positionned in a tank filled with fresh water.

A salted tracer is introduced in the column representing a borehole

The pump is started

The experience shows that it is necessary to renew 2-3 times the volume of the water contained in the borehole to eliminate the salted water



Experimental field of Hydro-Invest : fractured aquifer

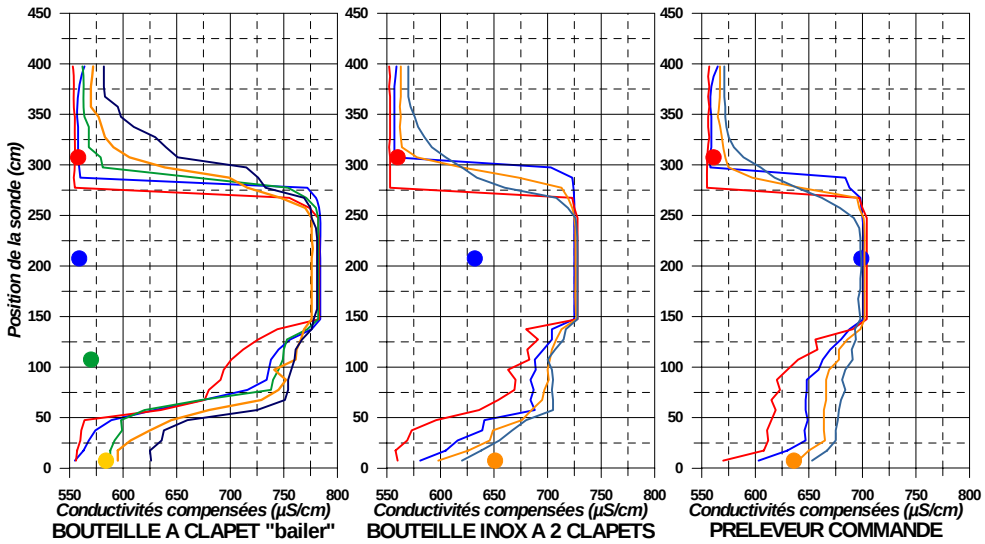
Natural stratification of groundwater with the lower part of aquifer with a high mineralized water

Experience :

-When the pump is located at a depth of 12 meters, the water is renewed between the surface and 12 meters depth

-When the pump is located at a depth of 5 meters, the water at the bottom of the borehole is not renewed because the fractures are located in the upper part of the borehole. The bottom part of the borehole do not have fractures and so do not circulate water

SAMPLING BY MANUAL SAMPLER



Pilote HYDRO INVEST.

Une stratification saline est créée dans le forage par circulation d'un traceur salin entre deux « fissures » situées à 1.5 et 2.5 mètres au dessus du fond.

Les diagraphies de conductivité permettent de visualiser l'état de salinité de l'eau dans le forage.

Différents types de préleveurs manuels ont été testés : les points de couleur indiquent la conductivité moyenne de l'eau prélevée, à la profondeur où a été descendu l'échantillonneur.

La représentativité de l'eau prélevée par un « bailer » simple est très mauvaise car l'eau ne se renouvelle presque plus dans le bailer une fois qu'il est plein, même si on continue à le descendre.

Dans un échantillonneur lourd (inox), la vitesse de descente est plus rapide et le renouvellement de l'eau dans l'échantillonneur est un peu meilleure ; mais la représentativité reste très médiocre.

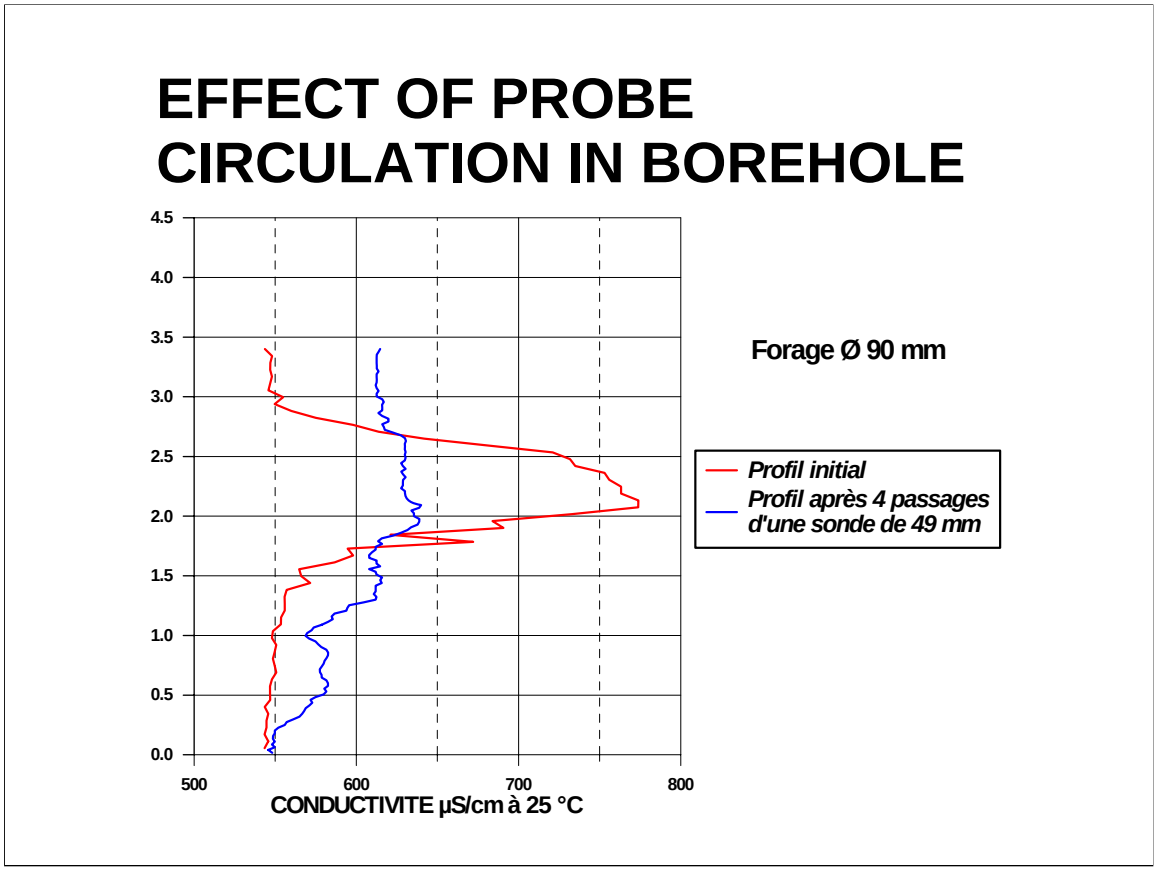
Le troisième exemple montre les bons résultats obtenus avec un préleveur à ouverture commandée.

Hydro-Invest pilot

A salted stratification is created in the borehole by circulating a salted tracer between 2 fractures located at 1.5 and 2.5 meter above the bottom of the borehole

The conductivity logging shows the salinity of water in the borehole.

Different types of samplers are tested : the coloured points indicate the average salinity of sampled water at the depth where the sampler has been moved down



Pilote HYDRO INVEST

Une anomalie de conductivité est créée dans un forage rempli d'eau douce par introduction localisée d'une solution salée.

Puis une sonde de conductivité est descendue à plusieurs reprises dans le forage (vitesse de descente et remontée de la sonde : 4 m/mn).

Les enregistrements montrent les perturbations apportées par les passages de la sonde (les perturbations sont plus légères avec une sonde de plus faible diamètre)

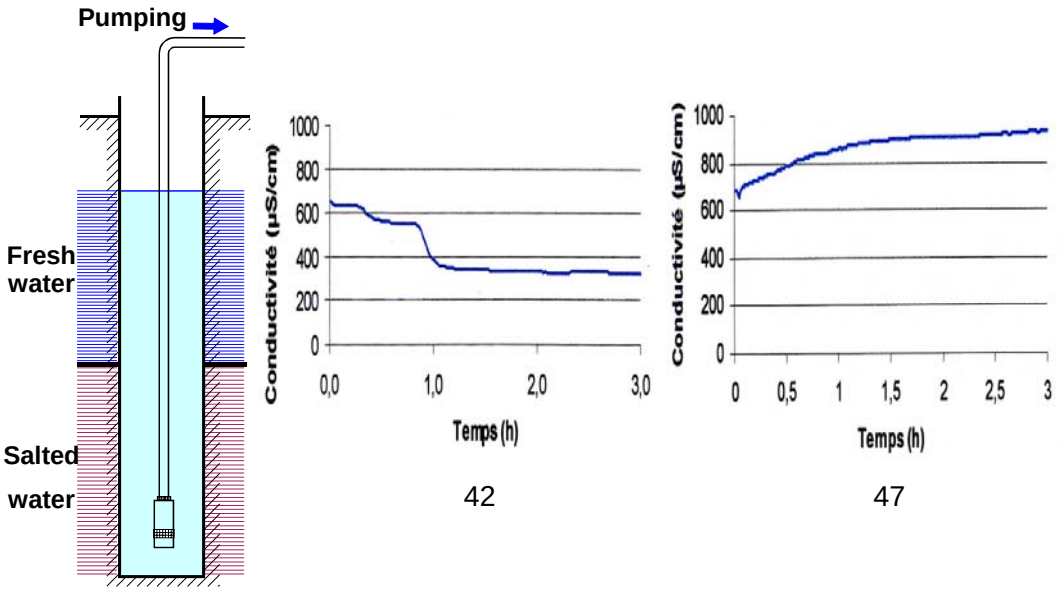
Pilot Hydro-Invest

Firstly an anomaly of conductivity is generated in a borehole filled with fresh water by introducing locally a salted solution

Secondly a probe to measure conductivity is circulated few times in the borehole from top to bottom and back (speed : 4 meters per minute).

The registrations show disturbances created by this circulation of the probe (disturbances are smaller with a probe of smaller diameter

« IDENTICAL» PROTOCOLES DIFFERENT RESULTS



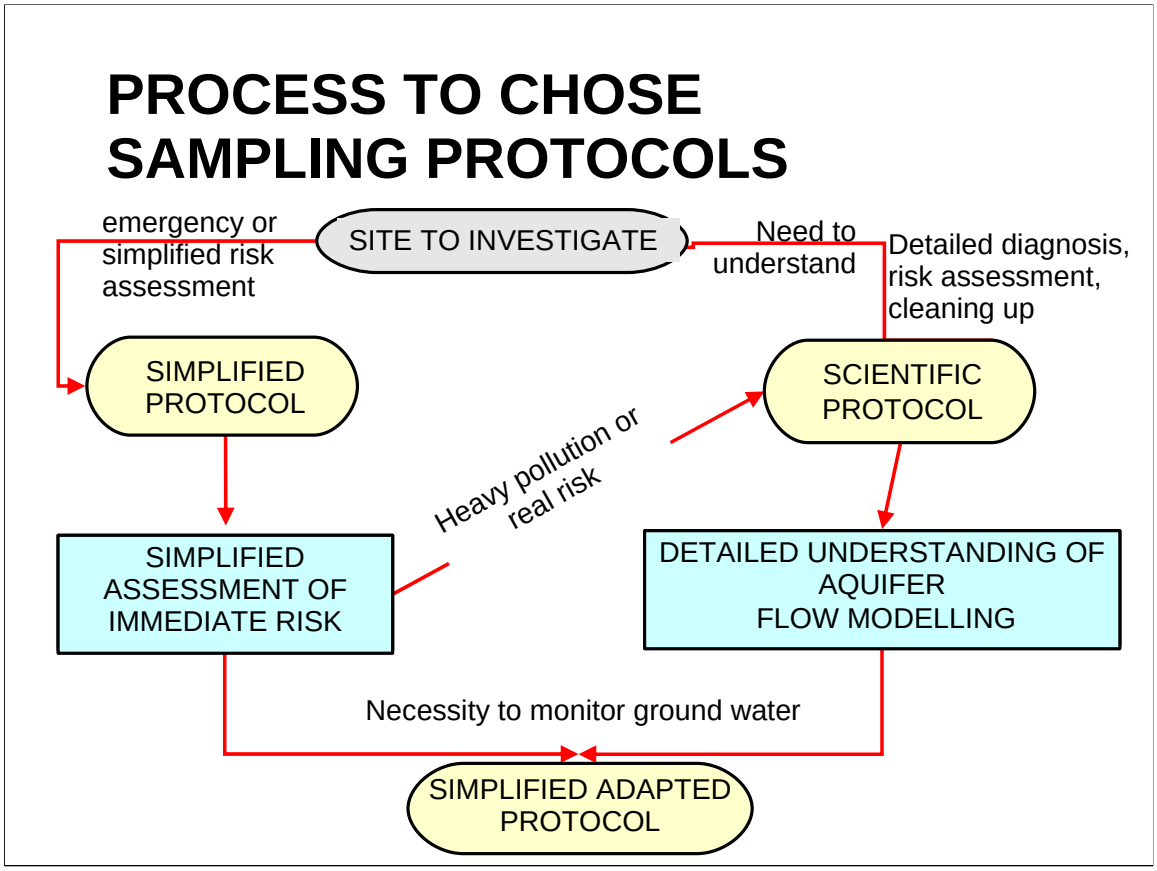
Pilot of the University of Pau

The borehole is “drilled” in an aquifer having 2 layers of different permeability and separated by a liner. the upper part of the aquifer is filled with fresh water and the lower part with salted water. The borehole itself is filled with water of intermediate conductivity and the pumping starts.

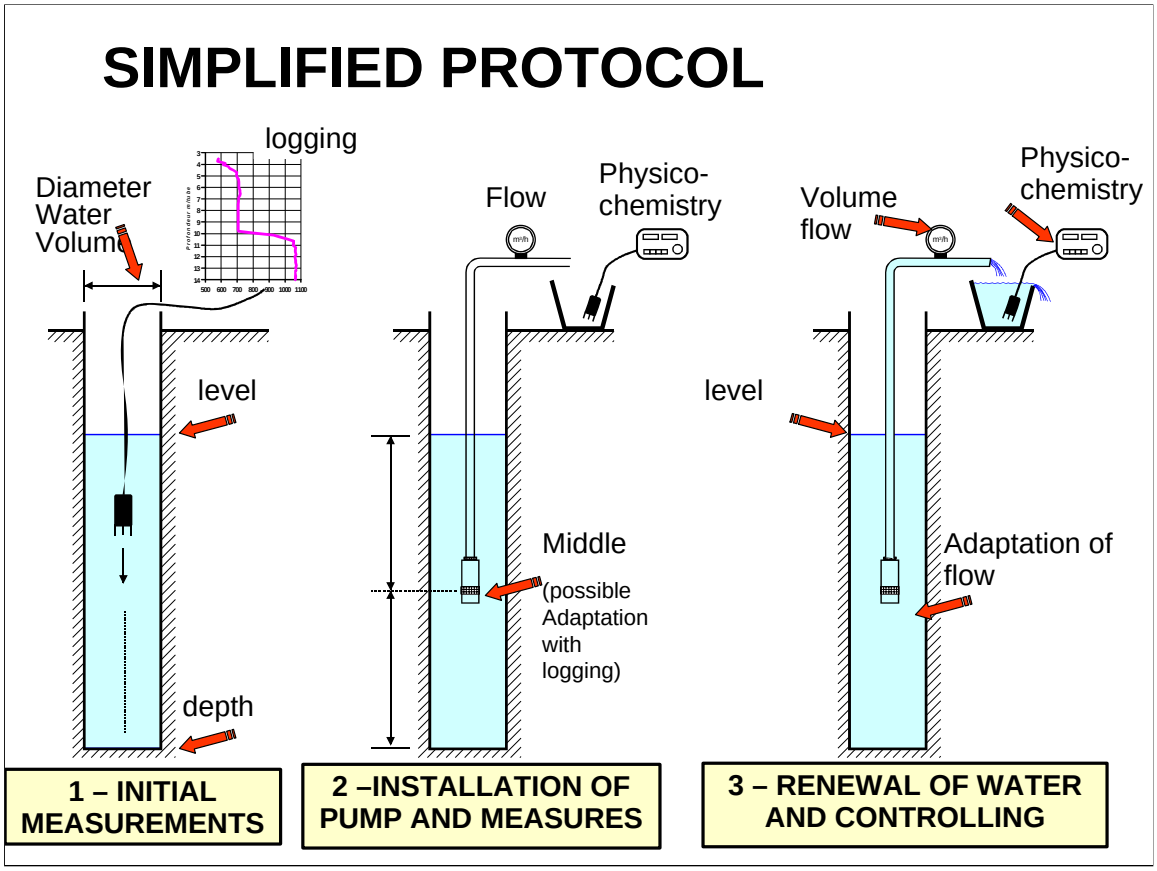
By using apparently similar procedures, some experiments produced at the exhaust of the pump fresh water from the upper part of the aquifer while other experiments produced salted water from the lower part of the aquifer.

These results can be explained as the result of the hydraulic load applied to the 2 different aquiferous layers during the pumping : small variations in hydraulic loads reverse the water flow between the layers of the aquifer in the borehole.

In the test number 42 the lower layer which is the contaminated layer is not sampled if waiting for the stabilization of the conductivity measured at the exhaust of the pump. This result demonstrates the necessity of borehole logging to identify a contamination which will not appear by the pumped water. These hydraulic conditions can also exist In natural aquifers.

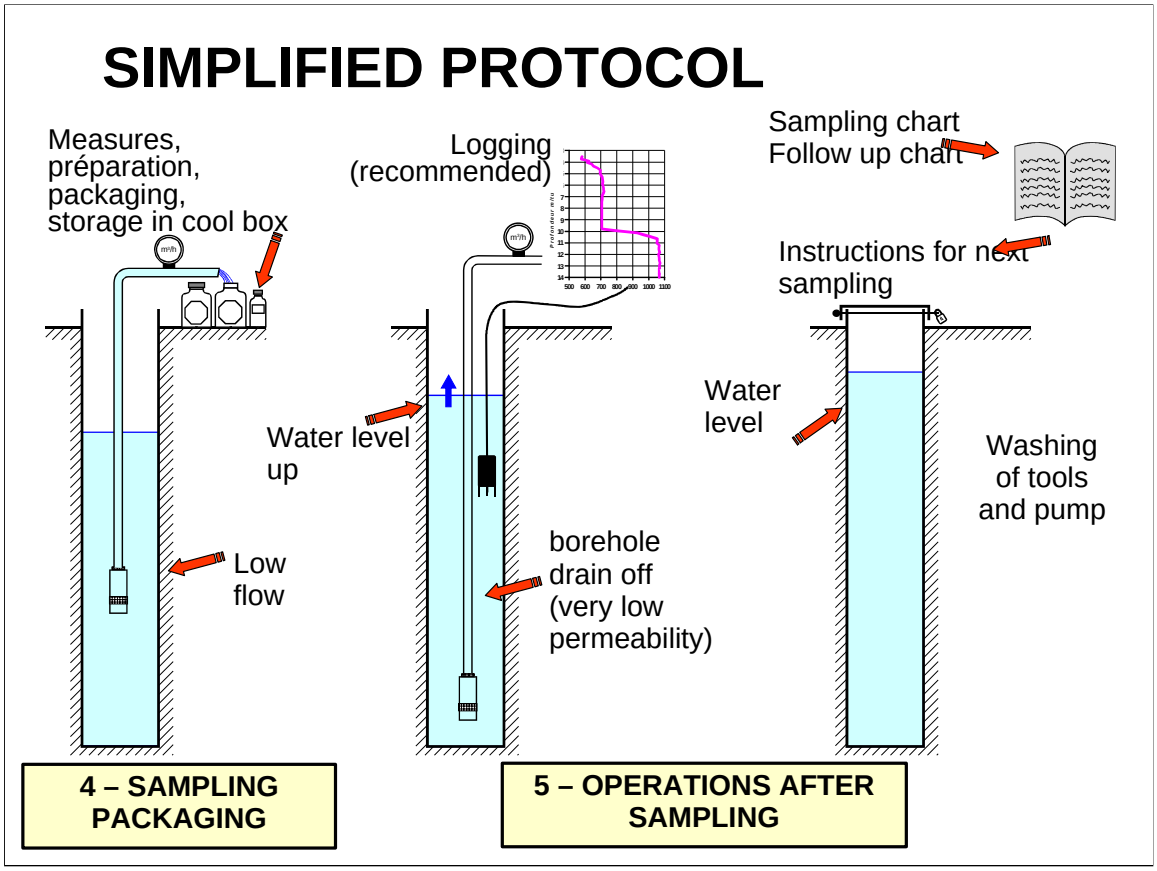


The results of this research on pilots scale and full size scale allow to propose sampling protocols adapted to the objectives of the sampling : considering the objectives and the knowledge of aquifers, differents protocols can be operated.

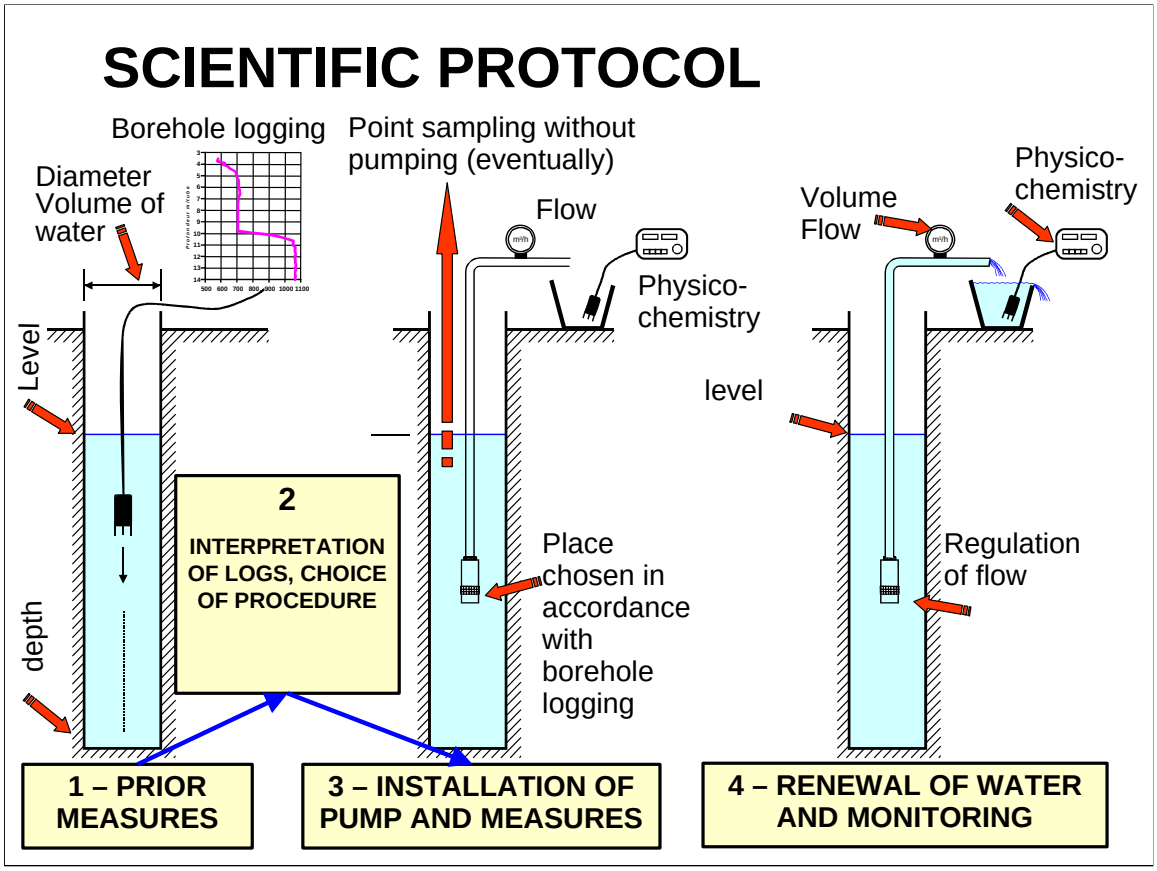


The simplified protocol should allow to briefly evaluate the risk related to the use of an aquifer for drinkable water.

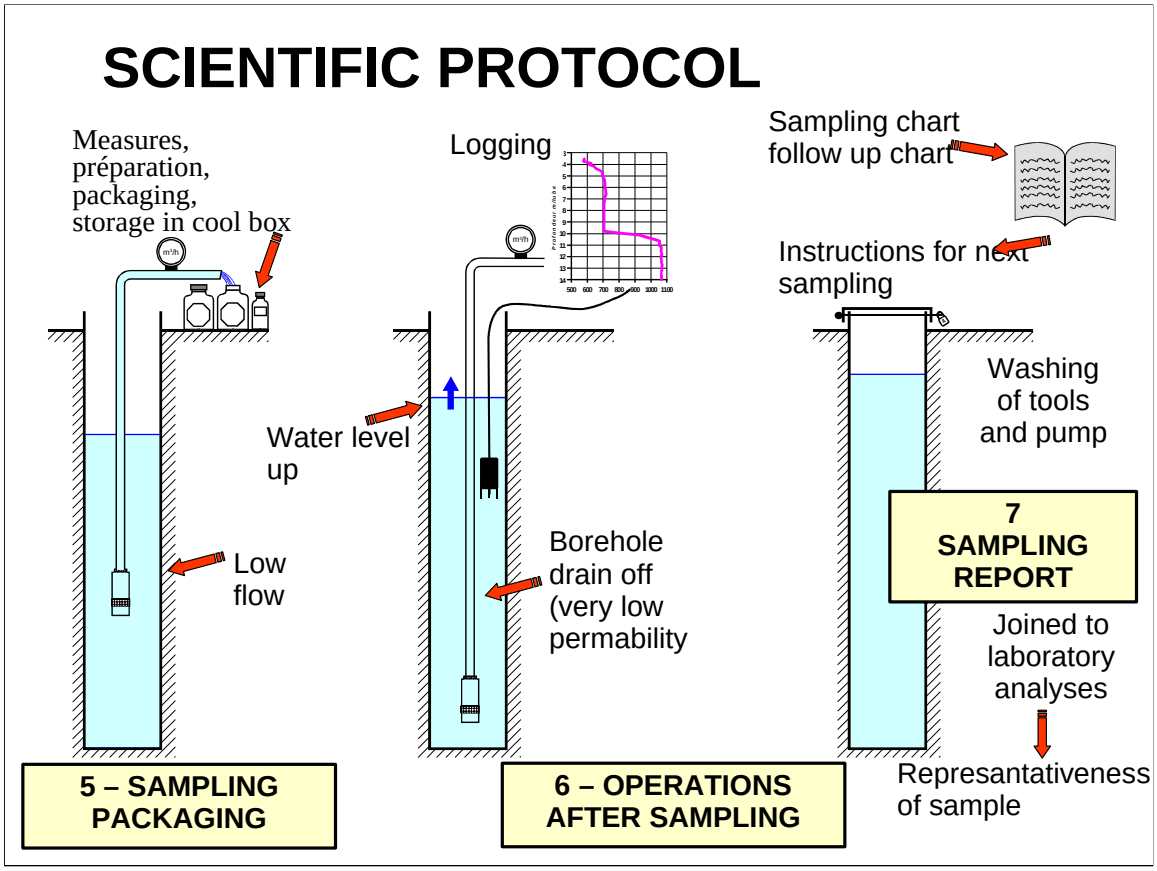
But it is not suitable to estimate and to model the “functioning” of an aquifer or to have a precise knowledge of the real contamination of this aquifer.



Sampling chart, follow up chart are necessary elements to try to evaluate the representativeness of samples



The scientific protocol lead to understand the functioning of the aquifer : therefore it is essential to record precisely the sampling conditions and to adopt a unique protocol which will allow to specify the origin and the degree of representativeness of the water sampled.



The sampling report presents an analysis of the sampling conditions and comments on the representativeness of the analysed samples. It produces data for comparison with the previous results obtained on the same borehole.

It can propose protocols to implement for the next sampling in the monitoring plan according to a simplified and adapted protocol.