Site Location Map

Project Details

COMPANY

Veolia

COUNTRY

France

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Aquisafe Project: Mitigation of Contaminants to Protect Water Resources in Rural and Semi-rural Areas Using Buffer Zones

CONTEXT

This project was a partnership between Veolia and the "Syndicat Mixte Environnemental du Goëlo et de l'Argoat" (SMEGA):

- **SMEGA** is an intercommunal cooperation establishment, financed by its subscribers (communities and water producers). Its role is to implement, in the name of its subscribers, management policies to sustainably maintain rural and public areas and integrate the environmental aspect into their actions. The SMEGA area of actions covers 113,000 hectares including two catchment areas: the "Grand Trieux et côtiers", and the "Ic et côtiers". Seven of 13 of its full-time technicians solely work on ecological engineering activities, in particular regarding actions on the biological and aquatic environment (wetlands and water streams).
- **Veolia** Group is a global leader in optimized resource management. With more than 179,000 employees worldwide, Veolia designs and provides water, waste, and energy management solutions that contribute to the sustainable development of communities and industries. Through its three complementary business activities, Veolia helps to develop access to resources, preserve available resources, and replenish them. In 2014, Veolia supplied 96 million people with drinking water and 60 million people with wastewater service, produced 52 million megawatt hours of energy, and converted 31 million metric tons of waste into new materials and energy. Veolia Environment (listed on Paris Euronext: VIE) recorded consolidated revenue of €24.4 billion in 2014.

In 2009, the Ic drinking water production plant (located in Brittany, France), operated by Veolia Water, was provisionally closed because nitrate concentrations in raw water were up to 120 mg NO_3/L, in excess of the statutory threshold of 50 milligrams per liter (mg/L), which should not be exceeded for drinking water provision in France.

The elected representatives of the SMEGA revealed its intention to pursue action to recover the aquatic environment water quality in the Ic catchment area (6,900 hectares upstream from the water intake) to continue using local water resources that comply with the regulations. However, to face this issue, the collectivities had to further their scientific knowledge to be able to identify long-term sustainable solutions.

SMEGA joined VEOLIA within the framework of the Aquisafe research project. The aim of this public-private partnership is to further the knowledge on the functioning of buffer zones in rural areas, optimize their functioning, and assess at catchment area scale their potential contribution to maintaining / preserving water quality, and in particular in the Ic catchment area.

Key stakeholders in this project included Veolia, SMEGA, Agence fédérale pour l'environnement Allemande (UBA), Indiana University Purdue University (IUPUI), Société d'Exploitation et de Gestion de Travaux (SEEGT), Institute for Landscape Ecology and Resources Management (ILR), and Umweltschutz Ingenieure Burkard und Partner (AKUT).

OBJECTIVE AND PROJECT OVERVIEW

The Aquisafe project aims to implement some measures that will prevent and mitigate contaminants coming from human activities in rural and semi-rural areas to protect the drinking water resources. It meets one of the fundamental challenges of water policy in France, which is preserving water resources and the aquatic environment.

Buffer zones in agricultural domains are artificial wetlands: retention basins, ponds of various depths, trenches planted with greeneries, or not, which catch the water coming from agricultural drains (run off water/drains) before returning to the stream. Natural processes take place in wetlands such as denitrification (nitrates), adsorption, biodegradation, etc. for organic micropollutants (pesticides) and purify the water.

As it was known that agricultural best practices are not sufficient to remove all contamination, the Aquisafe project aimed to evaluate the contributions of these created wetlands and other natural treatment systems to improve water quality output of the watershed and then to replicate these ecosystem services to prevent and mitigate the anthropogenic contaminants generated in rural and semi-rural areas to protect the drinking water resources.

In this context, the goal of this first project was to develop some knowledge on the functioning of buffer zones in rural areas, optimize their ability to reduce pollution coming from agricultural activities (the main targeted parameter being nitrates), and assess their possible contribution to protecting water quality in a drainage basin, more particularly the Ic drainage basin (6,900 hectares upstream from the water intake). This project tested the performance of three constructed buffer zones in agricultural areas where high levels of nitrates were observed.

THE BUSINESS CASE

As described above, excess levels of nitrates in water resulted in a closure of the Ic drinking water production plant in 2009. Veolia would need to maintain water quality standards of raw water coming into the plant (to less than 50 mg/L) to comply with regulations for using the local water resource for drinking water.

By developing an understanding of buffer zones and using constructed wetlands in agricultural areas, the water would be purified before entering the plant for treatment, thereby reducing the nitrogen levels entering the plant and meeting the regulatory requirements for continued operation.

DECISION MAKING PROCESS

Studies, and particularly hydrologic modeling, of the Ic river watershed have demonstrated that the improvement of the agricultural practices – which included limiting application of fertilizers and pesticides to crops, and treatment of agricultural effluents – would not be sufficient to restore the quality of water and meet the objectives set by the Water Framework Directive (WFD). Concurrently, publications highlighting the possible role of artificial buffer zones within the watershed to help restore the quality of water were emerging.

Therefore, Veolia, which was significantly impacted by the provisionally closure of the plant, decided in collaboration with SMEGA to initiate a research project to evaluate the potentialities of such "artificial buffer

zones". A valuation study was conducted by KWB, a Veolia Research Center, and positive outcomes have resulted in enhanced public health, and follow-on projects.

PROJECT DETAILS

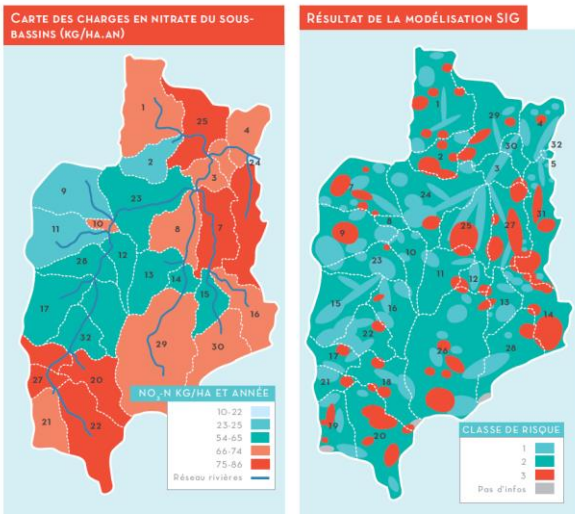
Buffer zones in agricultural domains are artificial wetlands that catch the water coming from agricultural areas and act as natural treatment systems. This project tested the performance of three constructed buffer zones in agricultural areas with high levels of pollution observed.

- Site 1: Reactive trench & Infiltration lagoon
- Site 2: Surface lagoon

The systems function by allowing infiltration of agricultural drainage horizontally or vertically through different types of material (wood chips, sand, or gravel) for the reactive trenches or through vegetation for lagoons. This process enables the denitrification and the retention/absorption, even elimination of micropollutants originating from agriculture.

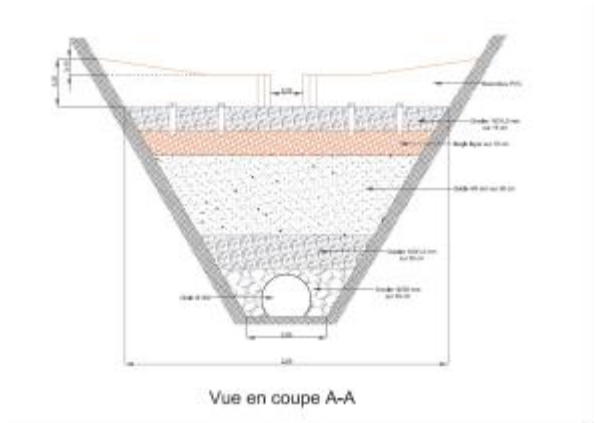
This was a three-phase project:

- Phase 1: Site identification, technology selection, and installation
  - Sites were identified using modeling and simulations to identify the zones contributing most significantly to nitrate pollution of the drainage basin: use of classic digital models (SWAT model) or geographic information system (GIS) as an alternative method when there was insufficient field data.
  - Choice of various types of buffer zones (reactive trench, infiltration lagoon and surface lagoon) were made based on their nitrate reduction potential and their low land coverage of agricultural areas.
  - Field investigations were used to choose the final location, depending on the topography and the land owners' agreement.



SWAT Modeling (Left); GIS Method (Right)

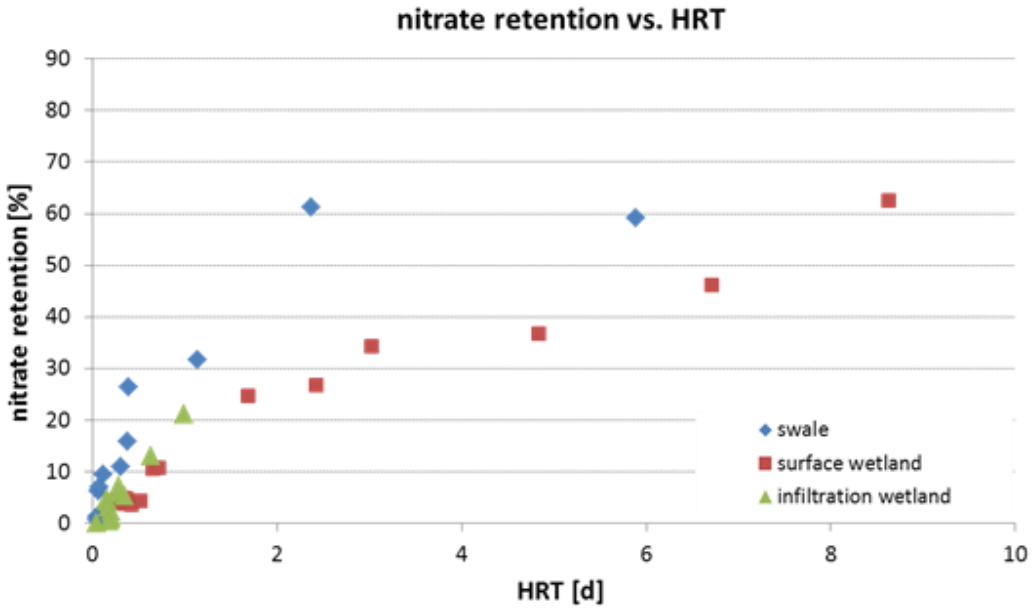
  - The implementation project was built based on simulations: use of the chosen SWAT model to simulate the results that can be obtained for water quality for the long-term production of drinking water using buffer zones spread over the drainage basin.
  - Complementary analyses (infiltration tests, topographic measurements, etc.) were conducted to refine the selection of the type of created buffer zone as well as the instruments needed for performance monitoring.
- Phase 2: Full-scale performance test of the treatment capacity of various natural and semi-natural constructed buffer zones:
  - Monitoring involved sampling the reduction of nutritive elements in buffer zones.
  - Removal rates of up to 80 percent of nitrates in the summer.
  - The reactive trench was more effective at removal than the lagoons.



Reactive trench (Site 1)

Infiltration Lagoon (Site 1)

Surface Lagoon (Site 2)



Nitrate removal according to the hydraulic retention time observed on field (pilot scale)

- Phase 3: Assessment of the results at water intake following the implantation of multiple zones in the drainage basin and association with other measures (improvement of agricultural practices) *(in progress)*

The total cost of the project was 1.4 M€:

- Construction works and maintenance of the sites (external estimated research and development works and detailed monitoring) have amounted to 72 k€ for three constructed buffer zones, over 3 years.
- The financing was born by SMEGA, with the support of the Agence de l'eau Loire-Bretagne, of the Région Bretagne - experimentally – and of the Conseil Général des Côtes d'Armor.
- Veolia financed the remaining costs of the project.

LESSONS LEARNED

A number of lessons were learned during this project:

- Although the constructed buffer zones required almost no agricultural land coverage, it was essential to work with the farmers to pre-select agricultural sites for the buffer zones, their maintenance, and monitoring.
- These solutions are complementary to implementing good agricultural practices and reducing the inputs. It is therefore important in parallel to ensure a dynamic implementation of best practices to be adopted by farmers.
- Selection of the type of constructed buffer zone must be done according to the pollutant to treat and accounting for high flow periods.
- System hydraulics must be closely defined to ensure effectiveness, particularly hydraulic residence time, which must be at least 1 day for trenches and 3 days for lagoons to allow for some elimination above 30 percent of nitrates.
- It is most valuable to preferentially install buffer zones in pollution hot spots – which can have the biggest impact – substantially improving water quality.

If these rules are followed, the implementation of buffer zones (reactive trenches, ponds, infiltration basins) at strategic locations of the watershed ("hot" spot of pollution) can significantly improve the quality of water streams, in particular to reduce nitrates' concentration.

FUTURE IMPLEMENTATION AND NEXT STEPS

Positive results of the study resulted in the decision to extend these systems on the watershed to improve the water quality by SMEGA. Also, a guide is forthcoming that summarizes the study findings and recommendations.

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