

# Permeable Reactive Barriers: the Multibarrier concept

## CASE STUDY: Landfill site Hooge Maey, Antwerp, Belgium

An innovative multibarrier concept was recently introduced for the passive in-situ treatment of landfill leachate contaminated groundwater<sup>1</sup>. Landfill leachate plumes are a classic example of complex groundwater contamination, containing a mixture of dissolved organic matter, inorganic components (e.g. ammonium), xenobiotic organic compounds (e.g. AOX, chlorinated hydrocarbons, phenols), and sometimes heavy metals. Efficient treatment requires different contaminant removal mechanisms to reach the target levels, which can be combined in a multibarrier. Due to its minimal maintenance and energy requirements during operation, multibarriers can offer significant economic advantages over conventional pump-and-treat systems.

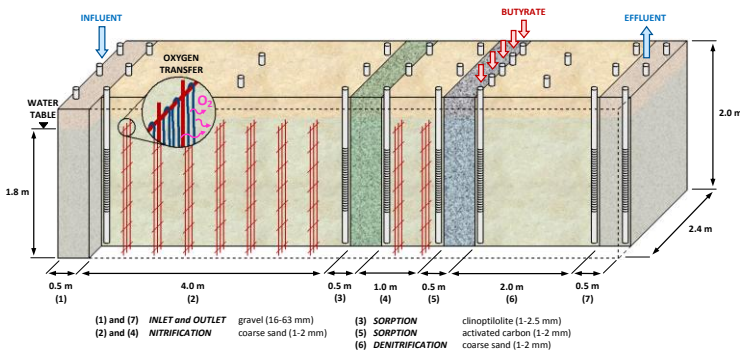
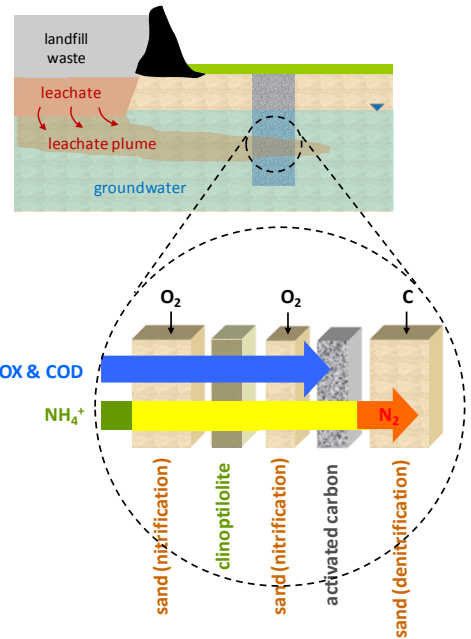
### 1. Site description

The landfill Hooge Maey is located in Antwerp, Belgium, and is one of the oldest active Flemish landfills, with dumping activities going on since 1967. This project focuses on an old confined part of the landfill which is in the methanogenic phase. The area has a size of 39 hectares and contains a heterogeneous mixture of industrial and municipal wastes. Leachate has accumulated in the landfill due to upwelling groundwater and infiltration of rainwater before confinement. In general, the leachate is characterized by elevated concentrations of  $\text{NH}_4^+$  ( $313 \pm 51 \text{ mg N L}^{-1}$ ), AOX ( $0.71 \pm 0.25 \text{ mg L}^{-1}$ ) and COD ( $389 \pm 36 \text{ mg L}^{-1}$ ). The leachate has a temperature of  $12.5 \pm 0.9 \text{ }^\circ\text{C}$ , an electrical conductivity of  $51 \pm 4 \text{ mS cm}^{-1}$  and a near-neutral pH ( $7.4 \pm 0.2$ ).



### 2. Multibarrier concept

As the Hooge Maey is a well-engineered landfill without groundwater contamination, the multibarrier concept was demonstrated on a pilot-scale level by pumping leachate through a compartmentalized and partly buried 9 m long steel container. Ammonium was removed by a sequence of microbiological degradation processes (nitrification-denitrification) and ion exchange on clinoptilolite. Granular activated carbon (GAC) was used to remove adsorbable organic halogens (AOX) and chemical oxygen demand (COD) by sorption. The microbiological treatment zones (nitrification and denitrification) were inoculated with sludge originating from the wastewater treatment plant of the landfill site. The nitrification compartments are equipped with diffusive oxygen transfer systems and the denitrification compartment is fed with iso-butyrate as a cheap carbon source. Regular monitoring and analyses indicated that all contaminant concentrations could be reduced to below the target levels.



<sup>1</sup> Van Nooten, T.; Diels, L.; Bastiaens, L. Design of a multifunctional permeable reactive barrier for the treatment of landfill leachate contamination: laboratory column evaluation. *Environ. Sci. Technol.* **2008**, *42*, 8890–8895.