aqualia

# Biodiversity

## Protection of Natural Capital and Ecosystem Restoration

**2024 ACTIVITY REPORT**

# Index

# Protection of Natural Capital

As part of the **Climate Emergency and Planet Preservation** action line of the **Aqualia's 2024-2026 Strategic Sustainability Plan (ASSP),** we work to protect and restore natural capital in the territories where we operate. In our end-to-end water cycle management, embedded in the natural environment, we redouble our efforts to prevent soil or water body contamination and minimize ecosystem impact.

At Aqualia, we manage facilities located near protected areas or regions of high biodiversity value. In these locations, we take action in two main ways:

- In accordance with **ISO 14001,** we care for protected areas through initiatives such as green roofs and walls, light emission reductions, pruning and mowing to control vegetation, and the restoration of ponds, wetlands, and riverbanks.

- We aim to be **proactive in the special care of protected areas,** with a particular focus on ecosystem preservation and species survival.

# Highlighted Projects in Biodiversity Protection and Ecosystem Restoration in 2024

# Biodiversity Biomass PPB

Utilization of biomass resulting from the purification process using Aqualia's ANPHORA® technology at the Linares Wastewater Treatment Plant (WWTP), the first 100% solar anaerobic eco-factory, to enhance agricultural soil fertilization.

Bird's-eye view of the 100% solar eco-factory at Linares WWTP.

## Location

**Linares WWTP (Jaén),**
the world's first 100% solar anaerobic eco-factory

## Project description and objectives

This project uses biomass resulting from the **purification process in anaerobic photobioreactors enriched with purple phototrophic bacteria** (PPB) at the Linares WWTP as raw material for the formulation of slow-release fertilizers (in pellet form).

Six agronomic trials were conducted in three different countries: **Italy** (Isola Sant'Antonio, Silvano Pietra, and Ferrera Erbognone); **France** (Grenade and Romans-sur-Isère); and **Spain** (Cuevas, León). These trials studied the effect of biomass on microbial activity, physicochemical properties, fertility, and biodiversity of these soils.

Above, dehydrated biomass; lower left, PPB biomass inside the photobioreactors; lower right, pellets applied in field tests.

## Partnerships and collaborators

This study was part of the DEEP PURPLE project, coordinated by Aqualia and co-financed by the **Circular Biobased Europe Joint Undertaking (CBE JU).** Aqualia acted as the biomass supplier, while Agro Innovation, a French multinational fertilizer company, carried out the pellet formulation and agronomic trials.

## Rationale for using Biomass PPB

The utilization of phototrophic biomass obtained through Aqualia's ANPHORA® technology for agricultural soil fertilization offers the following benefits:

- **Provides significant doses of nitrogen, phosphorus, and organic matter, potentially replacing substantial amounts of mineral fertilizers,** thus saving resources like phosphorus, whose reserves are limited, and nitrogen, reducing leaching and $CO_2$ emissions from its production.
- **Stimulates soil microorganism activity, leading to greater nutrient release** (nitrogen and phosphorus) that can enhance crop growth. Enriching the soil promotes the growth of a wider variety of plant species.
- **Increases fertility.** A greater diversity of plants can attract different species of insects, birds, and other animals, contributing to a more balanced ecosystem.
- **Improves soil structure and texture,** increasing its water retention and aeration capacity. This creates a more favorable environment for the growth of various plant types and provides habitats for diverse species.
- **Nutrient recycling.** Using nutrient-rich biomass (nitrogen and phosphorus) helps recycle nutrients that would otherwise be lost. This benefits plants and can improve the health of nearby aquatic ecosystems.
- **Promotes native species.** Soil enrichment can favor native plant species better adapted to local conditions, helping to maintain and increase plant diversity in the area.
- **Establishes new habitats.** Applying these pellets to agricultural soils creates microhabitats that support the growth of plants that would not typically thrive in degraded soils, including rare or endangered species.

# Soil Biodiversity in Ávila

Application of sewage sludge, biochar, and struvite as organic amendments for the restoration of degraded forest soils in Riofrío (Ávila).


1. Initial state of the plot.
2. Application of organic amendments.
3. First sampling (after 1 year of application).
4. Second sampling (after 2 years of application).

## Location

**Riofrío,** in the vicinity of the Sierra de Gredos Regional Park (Ávila).

## Project description and objectives

This project aims to **incorporate the following bioproducts into soils affected by a wildfire: sewage sludge, biochar** obtained from the thermal treatment of this sludge, and struvite recovered from urban wastewater treatment plants. The study site was a plot in the municipality of Riofrío (Ávila), which suffered a forest fire in the summer of 2021.

The project has monitored improvements in physicochemical properties, the concentration of available nutrients (mainly carbon, nitrogen, and phosphorus), enzymatic activity in the soil, and the diversity of the vegetation cover following the application of these amendments over a two-year period.

## Partnerships and collaborators

This study is part of a public-private collaboration between the **Composting Group of the University of Burgos,** responsible for the application of amendments and soil quality monitoring, and Aqualia, the supplier of sewage sludge, biochar, and struvite used as organic amendments.

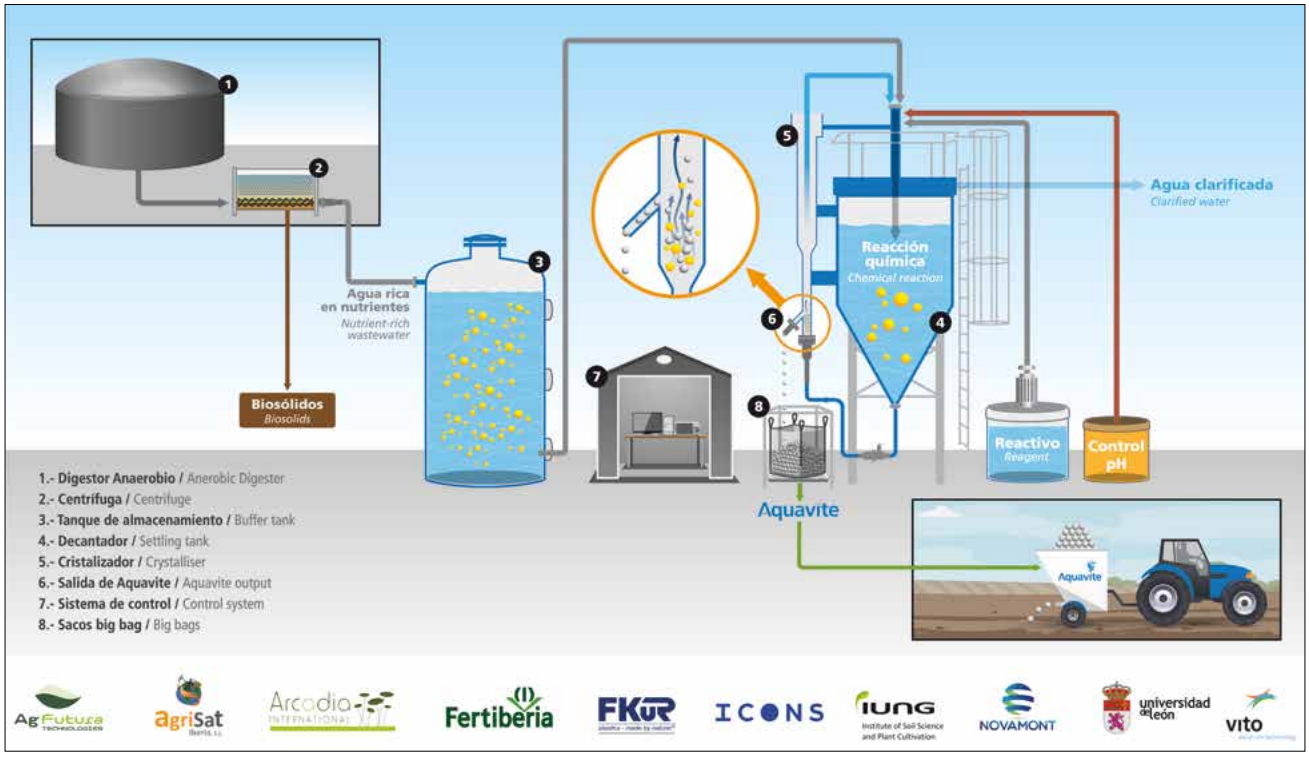
## Rationale for using sewage sludge, struvite, and biochar

The application of sewage sludge and derived by-products such as struvite and biochar as organic amendments for the environmental restoration of degraded soils offers several key benefits:

- **Increased soil fertility** through:
  - The provision of essential nutrients such as nitrogen, phosphorus, and potassium, which are fundamental for plant growth.
  - An increase in soil organic matter content without raising electrical conductivity, thus avoiding salinity. Soil organic matter serves as a food source for soil fauna and contributes to its biodiversity, acting as a reservoir of nutrients such as nitrogen, phosphorus, and sulfur.
- **Enhanced cation exchange capacity,** helping plants retain essential nutrients within the root zone due to the additional presence of cation binding sites. This, in turn, contributes to improved soil resistance to erosion.
- **Improved physicochemical properties of the soil,** facilitating the formation of aggregates that enhance aeration, reduce compaction, prevent erosion and desertification, protect natural habitats, and maintain biodiversity in vulnerable areas.
- **Reduced nitrate leaching,** preventing contamination of groundwater and aquifers.
- **Reactivation of microbiological and biochemical properties,** stimulating microbial and fungal proliferation and their metabolic activity, which is crucial for nutrient and water uptake from the soil. Bacteria and fungi are the most important organisms in the microbial community since they are responsible for most decomposition processes.
- **Increased vegetation cover.** Enhanced vegetation cover can reduce soil erosion and increase plant biodiversity, thus providing habitats for a wider range of animal species.
- **Improved and preserved native soil biodiversity.** The increase in the number of species is related to the greater availability of nutrients from the mineralization of sewage sludge. With greater competition among species, the distribution becomes more balanced, providing greater stability and maturity in the plant community.
- **Interaction with soil microbiota.** Sludge can introduce beneficial microorganisms that help decompose organic matter and release nutrients, which in turn can promote the growth of a greater diversity of plants.
- **Weed control.** The use of sludge can help control weed proliferation, allowing desired species more space and resources to grow.
- **Promotion of resilience.** Greater plant diversity makes ecosystems more resilient to environmental changes, pests, and diseases. All of this contributes to the overall stability of the ecosystem.

# Biodiversity enhancement with Aquavite®

B -FERST: Bio-based FERtilising products as the best practice for agricultural management SusTainability.




## Location

**Guadalete WWTP,**
in Jerez de la Frontera (Cádiz).

## Project description and objectives

**Valorization of biowaste in agriculture** through the creation of new circular and bio-based value chains. The project enhances the sustainability of arable land by developing eight innovative bio-based fertilizers.

The aim was to develop proprietary technology for phosphorus recovery in the form of struvite from the liquid fraction of anaerobic digestion digestates at WWTPs. The recovery process was developed in collaboration with the **University of Santiago de Compostela** (European Patent EP3112320A1 *Method and system for the crystallization of struvite for recovering phosphates in wastewater).* The phosphorus-rich recovered product has been registered under the name **Aquavite®.**

The ultimate goal of the project is to improve collaboration between farmers and bio-based industries.

## Partnerships and collaborators

To understand the benefits of Aquavite® in agronomic uses, a public-private collaboration has been established between the Eco-efficiency area of the Innovation and Technology department of Aqualia, the **Agronomic Engineering department of the University of Seville,** and **IFAPA** (Andalusian Institute of Agricultural, Fisheries, Food and Organic Production Research and Training).

In this collaboration, the Aquavite® product will be used as one of the biofertilizers that serve as an alternative to mineral phosphate fertilization. This biofertilizer will be included in a field experiment on 30 m² plots located at the IFAPA Tomejil facilities (Carmona). Four replicates will be conducted to evaluate its capacity to replace single superphosphate at the same phosphorus dose (30 kg/ha). Additionally, an unfertilized control will be carried out, and eight other biofertilizers will be used.

The trial will last a total of three years, in accordance with the usual rotation of Andalusian dryland crops (barley, sunflower, and triticale). The trial will evaluate all parameters related to yield, as well as different enzymatic activities at the phenological stage of maximum activity for each crop, to analyze the influence of the type of fertilization on the biodiversity of soil microorganisms. Thus, the use of a residue such as struvite, from the WWTP, can reduce the environmental impact—derived from the mining industry—and contribute to the circular economy.

## Rationale for using Aquavite®

- **Improvement of soil health.** Struvite improves soil structure, increasing its water and nutrient retention capacity. This creates a more favorable environment for microbial life and soil fauna, such as earthworms and other invertebrates, which are essential for maintaining healthy and biodiverse soil.

- **Increase in microbial activity.** Struvite provides a source of phosphorus and nitrogen, which are slowly released, promoting the growth of beneficial microorganisms in the soil. These organisms decompose organic matter and release additional nutrients, thus improving soil fertility and promoting greater plant diversity.

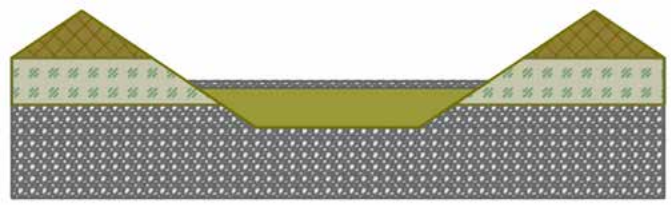
- **Reduction of pollution.** By using struvite, the need for chemical fertilizers, which often contain compounds that can be harmful to soil life and aquatic ecosystems, is reduced. This helps maintain ecological balance and protect biodiversity in and around agricultural areas.

- **Promotion of crop diversity.** Improved soil fertility and nutrient availability enable farmers to grow a greater variety of plants. Crop diversity is crucial for biodiversity, as different plants attract different species of insects, birds, and other animals, creating a more balanced and resilient ecosystem.

- **Mitigation of eutrophication.** Struvite helps prevent the leaching of phosphorus and nitrogen into nearby water bodies, reducing the risk of eutrophication. Eutrophication can cause algal blooms and decreased oxygen levels in the water, negatively affecting aquatic life. By keeping these nutrients in the soil, the biodiversity of aquatic ecosystems is protected.

# MARadentro BIODIVERSITY

MARadentro, managed aquifer recharge with reclaimed water in Medina del Campo.

**Top Layer:** 15 cm. Serving as a pre-filter and protection for the reactive layer. Composed of sands and sedimentary material.

**Reactive Layer:** 1 m. Composed of 51% fine-grained sedimentary material and clay from the pond excavation, and 49% organic matter (compost, wood chips, and charcoal).

## Location

The project is carried out near the **Medina de Campo WWTP** (Valladolid), adjacent to the lagoons that, after environmental restoration, have managed to attract numerous species of birds and create a biodiverse environment. The passage of a large number of migratory birds currently accounts for 80% of the biodiversity index of natural spaces of great importance such as Doñana.

## Project description and objectives

The project involves **managed aquifer recharge through infiltration ponds with water from the WWTP,** aiming to improve groundwater quality and aid in its recovery.

The process is carried out in sustainable and environmentally friendly manner: a natural reserve that complements the biodiversity-rich lagoons near the Medina de Campo WWTP, a premier and leading environmental center.

## Partnerships and collaborators

The prototype and design of the pilot system and infiltration ponds have been made possible through collaboration of hydrogeology experts from the **Polytechnic University of Catalonia** and **IDAEA-CSIC** (Institute of Environmental Diagnosis and Water Studies).

## Rationale for using MARadentro

In addition to serving as a tertiary system and a water management tool for storing and improving resource quality, managed aquifer recharge through infiltration ponds provides a significant boost to local and regional biodiversity.

- **Creation and restoration of natural habitats.** Infiltration ponds can create new temporary or permanent aquatic spaces, resulting in valuable habitats for various species of flora and fauna. These water bodies can be used by birds, amphibians, insects, and other organisms, fostering an ecosystem that increases the area's biodiversity. Additionally, as the water is of good quality, it contributes to improving the living conditions of local species.

- **Improvement of groundwater quality and its impact on wildlife.** Enhancing aquifer water quality not only ensures resource availability but also protects organisms that directly depend on these groundwater sources. This technique helps prevent ecosystem degradation due to contaminants or poor water quality.

- **Stabilization of adjacent aquatic ecosystems.** Maintaining aquifer levels and capacity through managed recharge helps stabilize water availability in nearby ecosystems such as rivers, wetlands, and lagoons, which often depend on these underground sources. This protects biodiversity in these ecosystems, which are critical refuges for endangered and ecologically valuable species.

- **Promotion of ecological connectivity.** Artificial wetlands generated during the recharge process can serve as ecological corridors, promoting connectivity between different habitats. This is particularly valuable for bird migration and the movement of other species, enhancing their ability to adapt and expand within a frequently fragmented landscape.

- **Benefits for soil flora and microfauna.** Infiltration enriches the soil, promoting biodiversity at the microorganism level, which in turn benefits native flora.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