

RECUP-DAS

Restoring Ecosystems Affected by Acid Mine Drainage through Dispersed Alkaline Substrate Treatment and Environmental Monitoring

A masterclass framework for digital ecosystem restoration

The Framework · WHY? · WHAT? · HOW? · WHO? · WHEN?

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The overall objective of the RECUP-DAS project is to **monitor and evaluate**, through the **LifeWatch ERIC e-Science Infrastructure**, the effectiveness of **acid mine drainage treatment and the associated ecosystem recovery**, by implementing passive decontamination processes (**DAS system**) and analyzing the impact on biodiversity and mining environmental liabilities in the Odiel River basin, thereby effectively contributing to the ecological transition of Andalucía.

The Masterclass Lens

RECUP-DAS as a framework, not only a project

A structured way to move from a local Andalusian investment to a scalable European restoration model, designed for other regions and other types of aquatic pollution.

WHY?

the problem and
ambition

WHAT?

the components of the
solution

HOW?

the method and data
pathway

WHO?

the partnership and
users

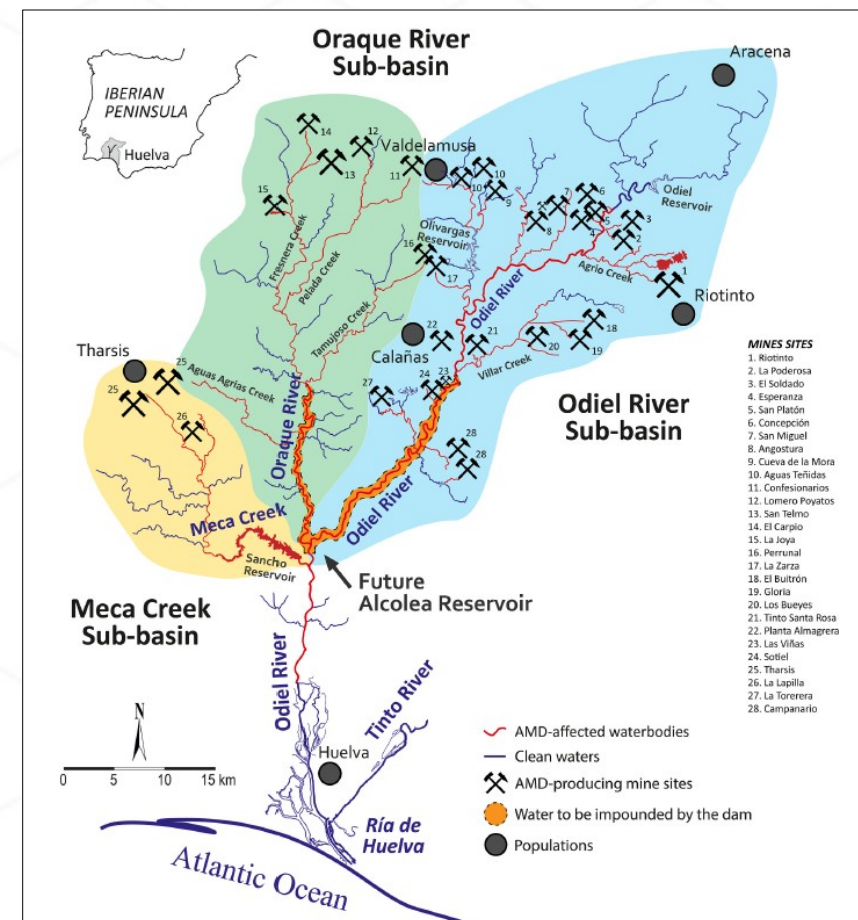
WHEN?

the implementation
sequence - roadmap

12-minute message: RECUP-DAS is a reusable recipe for digital restoration.

Restoration becomes reusable when it is organised as a system

- **1 Passive remediation** DAS treats acid mine drainage through a low-energy, gravity-based process.
- **2 Continuous monitoring** Sensors, field campaigns and laboratory analyses track change before and after intervention.
- **3 Digital intelligence** FAIR data, workflows, analytics and visualisation feed a future Digital Twin.
- **4 Ecosystem recovery** Biodiversity, hydrosphere, lithosphere and atmosphere are analysed together.



Key idea: design a local intervention so that knowledge, data and services can be transferred.

Because acid mine drainage is a long-term ecosystem-health challenge

The challenge is not only acidic water. It affects rivers, riverbanks, restoration sites, biodiversity, landscape functions, societal goods and benefits, such as future land use.

Key impacts

Centuries of mining have created persistent pollution pressure.

The Odriel basin requires monitoring before and after intervention.

The model must be applicable beyond one mine and beyond one pollution source.

The scientific question is ecosystem recovery, not only decontamination.

? Ecosystem degradation

? Water quality deterioration

? Social impacts

? Economic losses

Masterclass point: define the problem broadly enough to design a reusable solution.

A Digital Twin framework for ecosystem health and restoration

RECUP-DAS is built on five approaches that reinforce each other:

DAS treatment

— passive water regeneration

BACI design

— before · after · control · impact

Four spheres

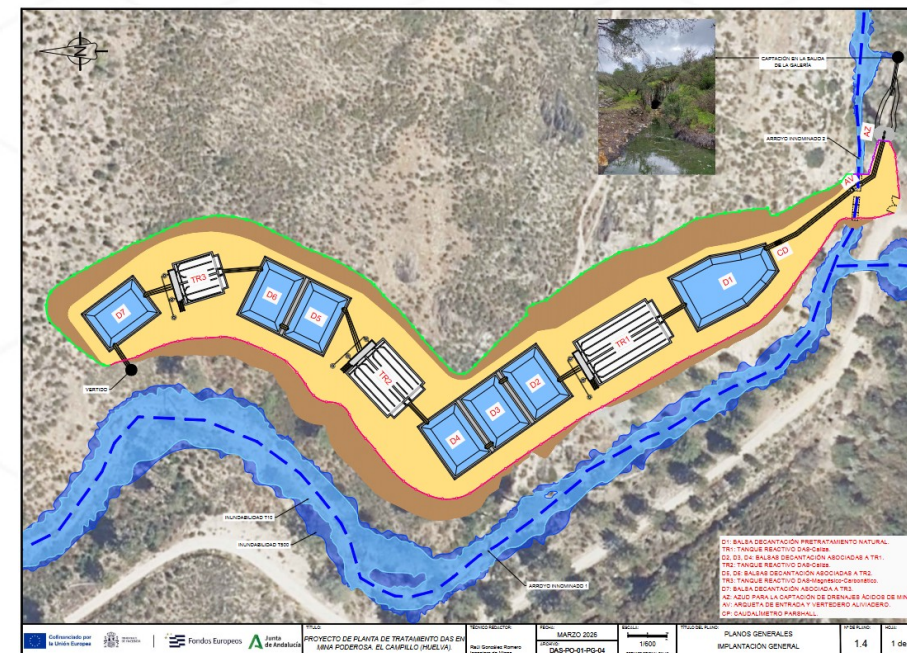
— air · water · soil · biosphere

Data ecosystem

— FAIR data · workflows · QA/QC

Digital Twin

— prediction · decision support · transfer



The product is not only a treatment plant: it is a scalable monitoring and knowledge system, transferable to other European areas and pollution contexts.

The BACI logic and the LifeWatch data pathway

BACI = Before · After · Control · Impact

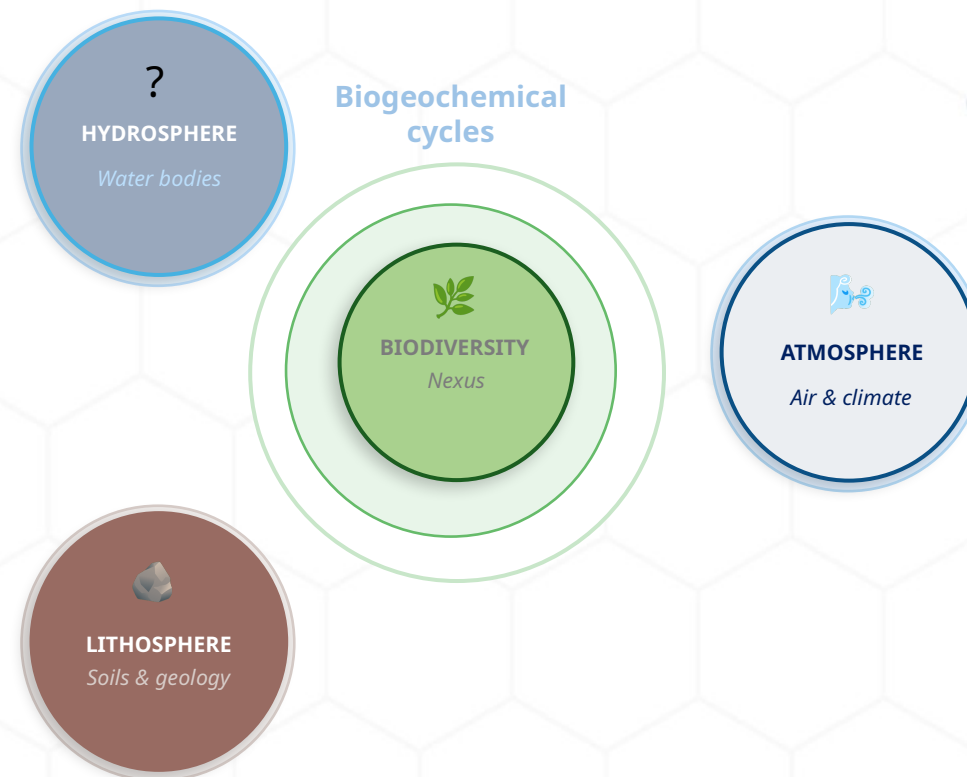
Detect change, not just status.

1 Measure
field · sensors · lab

2 Curate
QA/QC · metadata

3 Analyse
statistics · workflows

4 Decide
visualisation · twin



Four environmental spheres are integrated throughout the pathway: atmosphere, hydrosphere, lithosphere and biosphere.

Designed for upscaling and outscaling: more sites, more stressors, more reusable workflows.

A partnership model that mobilises the full LifeWatch ERIC capacity

LifeWatch ERIC

All Common Facilities and the Distributed Centres from participating countries contribute e-Science, data, workflow and Digital Twin capacity.

University of Huelva

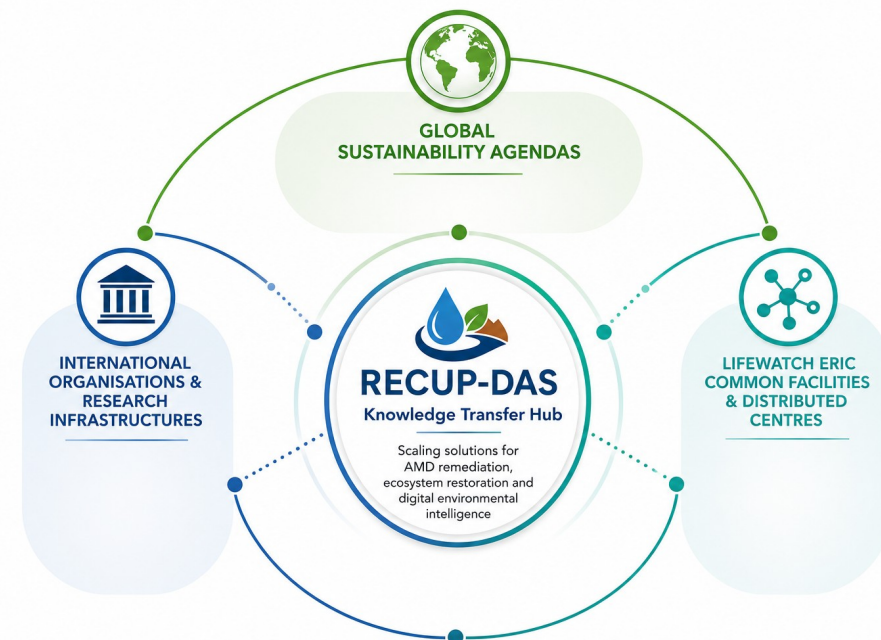
DAS technology and acid mine drainage scientific expertise.

AMAYA / Junta de Andalucía

Implementation context, environmental authorities and regional ecological transition.

Users & stakeholders

Researchers, policy actors, local authorities and restoration managers.



This is a Research Infrastructure delivery model: no single country has to assemble the whole technological and scientific chain alone.

A phased pathway from baseline to transferable model

- 1 **Baseline** historical data · indicators
- 2 **DAS** construction · operation
- 3 **Monitoring** BACI · sensors · campaigns
- 4 **Analysis** QA/QC · workflows
- 5 **Digital Twin** decision support · scenarios
- 6 **Transfer** European regions · pollution types

*The sequence is designed to keep the talk simple:
problem → system → pathway → partnership → transfer.*

WP	Focus Area	Key Activities
WP1	Project Management	Governance, monitoring, reporting and compliance
WP2	DAS Implementation	Design, construction and operation of passive treatment system
WP3	Digital Infrastructure & Monitoring	Environmental monitoring, FAIR data and Digital Twin
WP4	Scientific Sustainability	Baseline assessment, restoration and impact evaluation
WP5	Communication & Exploitation	Stakeholder engagement, dissemination and scalability

RECUP-DAS combines passive AMD remediation, environmental monitoring, digital technologies and ecosystem assessment to transform mining environmental liabilities into measurable ecological recovery, delivered through a collaborative framework involving LifeWatch ERIC, the University of Huelva, AMAYA and the Andalusian Regional Government.

Why this is a strong Return on Investment example

Local investment, European design

Andalusia invests locally, but the model is built for transfer across Europe and across pollution types.

Full RI mobilisation

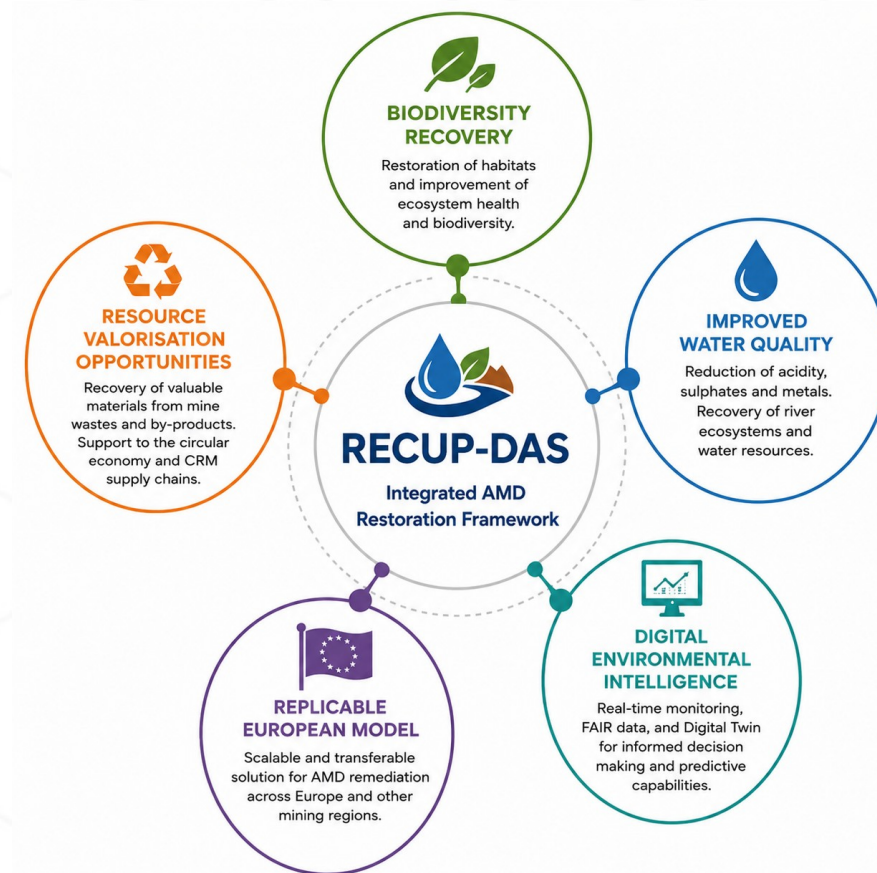
Common Facilities and participating Distributed Centres contribute complementary capacities.

Research Product beyond national reach

The Digital Twin framework, workflows, data ecosystem and technologies are more complex than any country could build alone.

Access to technology

Members gain access to shared analytical, computational and digital capabilities.



Core message: RECUP-DAS turns a regional restoration challenge into a reusable LifeWatch ERIC Research Product.

THANK YOU!

Questions?

RECUP-DAS

From passive remediation to digital environmental intelligence

Framework · WHY · WHAT · HOW · WHO · WHEN