The Vonarje flood storage reservoir in Croatia

Year of issue

2025

Summary

The Sutlansko Lake area is a wetland with a high biological diversity. The Vonarje reservoir was initially built in the early 1980s for drinking water supply, irrigation and flood protection along the transboundary Sutla/Sotla River between Croatia and Slovenia. The reservoir was later drained due to difficulties in managing its water quality and sedimentation. Since then, it has operated as a dry retention basin for flood protection. At the bottom of the reservoir, wetland ecosystems gradually developed. For this reason, the area of the reservoir on the Slovene side has been designated as a Natura 2000 site.

In recent years, the reservoir infrastructure was modernised through the FRISCO 2.1 project (2017–2019), funded by the Interreg V-A Slovenia–Croatia programme. The project aimed to reduce cross-border flood risks by reinforcing and upgrading the Vonarje dam and associated hydro-mechanical and electrical systems. The works were completed in 2019, enhancing the safety and functionality of the flood retention structure and improving its operational reliability.

The retention basin continues to serve as a key flood protection measure in the rural transboundary basin, offering temporary water storage during flood events while supporting ecological functions. Hydrological and sediment modelling have shown that the structure plays an important role in managing downstream sediment and nutrient flows, despite ongoing pressures from agricultural and point-source pollution.

Photo Gallery



Location

46.181, 15.628

Project

NWRM

National ID

Croatia_03

Sector

Hydromorphology

Installation Date

1980

Implementation status

Ongoing

Contact

Adriana Raveau, ACTeon

Overview

Location of the project

The Vonarje reservoir is located near the village of Vonarje, directly on the Slovenia–Croatia border, adjacent to road 107 between Hum na Sutli (Croatia) and Podčetrtek (Slovenia).

Country

Croatia

NUTS2 Code

Kontinentalna Hrvatska

Sponge measures implemented in the case study

Basins

Wetland restoration and management

Objectives

Flood prevention, downstream water quality improvements

Involved partners

Authority type	Authority name	Authority role
Regional / sub-national water authority	Slovenian government	Financing

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Site Information

Climate Zone

Cool temperate moist

Precipitation

1200.00 mm

Temperature (°C)

11.00 °C

Evapotranspiration

650.00 mm

Runoff

27.00 mm

Elevation range

324

WFD Ecological status

Moderate

WFD Chemical status

Failing to achieve good

Water quality status

The reservoir suffered from extreme eutrophication shortly after its creation, leading to drainage in 1988.Even today, nutrient and sediment loads remain problematic due to diffuse and point pollution (agriculture, industry, wastewater).

Design and Implementation

Project scale

Meso

Project scale specifications

Affects a significant part of a watershed, protecting several municipalities from flood risks.

Area subject to Land use change or Management/Practice change (ha)

590.60 ha

Financing

Financing authorities

Authority name	Type of funding	Comments
Slovenia and Croatia	National funds	The reservoir was built as part of the joint water management plans of Croatia and Slovenia.

Policy and Governance

Policy targets

Peak-flow reduction

Part of a wider plan

No

Public consultation

No

Has contractual arrangements

No

Impacts and Monitoring

Monitoring System

Monitoring requirements

Water quality is monitored at four stations in Croatia

Monitoring parameters

Parameters mentioned include overall water quality class trends, nutrients (N, P) and sediments.

Maintenance

Maintenance requirements

Modernization and equipement upgrade once, during the FRISCO 2.1 project (2017-2019)

Socio-economic Impacts

Direct benefits

The structure reduces flood risk for several towns (e.g., Hum na Sutli, Podčetrtek, Rogaška Slatina), increasing local safety.

Ancillary benefits information

The area has potential for tourism and education, including proposals for:
Recreation and eco-tourism
Nature learning areas
Cultural and wellness tourism (e.g., nearby spas)

Biophysical impacts: Hydrology

Retained water

12400000.00

Retained water unit

m3/day

Information on retained water

Capacity is 12.4 million m3, of which 3.7 million m3 is required for 100-year flood protection.

Information on reducing flood risks quantity

The dry retention basin helps mitigate floods by temporarily storing water during high-flow eventsHydrological modelling (HEC-HMS and SWAT) confirms its importance for downstream flood protection.

Biophysical impacts: Biodiversity

Improved biodiversity

Yes

Information on improved biodiversity

The Vonarsko Lake area with its specific geographical features, as well as ecological and economic characteristics, has numerous water resources and an extremely rich flora and fauna. This area is considered as a wetland, the value of which is reflected in the biological diversity of the flora and fauna, ecosystems, and landscapes. This region is also extremely important for research and education. In short, there are many reasons for preservation and protection.

Biophysical impacts: Water & Soil Quality

Water quality overall improvements

Not relevant for this application

Information on water quality overall

Due to the implementation of the European industrial and urban waste water treatment legislation and environmental agricultural policy in Slovenia and Croatia (Croatia becoming a new EU member State in 2013), emissions to water and risk to water quality in the Vonarje reservoirs are expected to be much lower in the future than in the 1980's. Nevertheless, past pollution residuals in the lake bottom, pollution due to higher traffic, pressure on the water environment from fisheries, touristic and recrational facilities, intensification of agricultural activities and expected changes of climate patterns do not necessarily support this expectation. Furthermore, uses of the catchment on the Slovene an Croatian side are a different. On the Slovene side, there is more industry, "industrial like" tourism (large congress, termal and wellness facilities) and larger urban areas. On the Croatian side, the catchment uses are mostly traditional agriculture. The water uses are less intensive. Waste water collection and treatment depend on settlement patterns and differ in the technologies applied.

Soil quality overall improvements

Positive impact-SQ improvement

Information on soil quality overall improvements

At the bottom of the reservoir wetland ecosystems developed. For this reason, the area of the reservoir on the Slovene side has been declared as Natura 2000 site.

Biophysical impacts: Others

Information on ecosystem impact climate regulation

No information found

Lessons Learned

Key lessons

The Sutlansko Lake area is a wetland with a high biological diversity. The Vonarje reservoir was initially built for drinking water supply and flood protection. The reservoir was drained due to difficulties encountered to manage its water quality. Now it operates as a dry retention basin for flood protection. At the bottom of the reservoir, wetland ecosystems developed. For this reason the area of the reservoir on the Slovene side has been declared as a Natura 2000 site.

Barriers

Barrier type	Barrier role	Comments
Other	Main barrier	Shortly after filling, water in the reservoir became eutrophicated. Furthermore, other extreme water quality problems have been detected not only in the lake water, but also in the river water downstream. There was a high risk to human and environmental health that has hardly been managed successfully. In the absence of better remediation measures, the reservoir was completely drained in 1988 and now operates only as a dry retention basin for flood protection.

Drivers

Driver type	Driver role	Comments
Other	Main driver	The main purpose was drinking water supply for both, Slovene and Croatian, settlements and flood protection of downstream areas.

Success factors

Success factor type	Success factor role	Comments
Successful coordination between authorities	Main factor	Both EU countries, Slovenia and Croatia, are expected to apply for new development and cohesion funds to develop environmental and other infrastructure in the catchment. For the water management, it is important to take into account the two national institutional systems and the different economic developments in the past two decades: Although there are strong cultural ties between local communites on both river sides, the challenge for catchment water quality management to secure good ecological and chemical status of the Sotla river today is even greater than it has been in the past.

Transferability

The concept of converting a degraded reservoir into a dry flood retention basin with ecological co-benefits could be adapted in other rural transboundary basins facing water quality degradation, sediment/nutrient pressures and/or flood risks.

Sources

Sources

Analysis of inadequate water quality of the Vonarje reservoir / Sutla Lake and the possibility of restoration and utilisation.

Hydrological and Hydraulic Modelling of the Vonarje Retention Basin

FRISCO 2.1 – Prekogranično usklađeno smanjenje rizika od poplava 2.1 – Modernizacija i nadgradnja brane Vonarje

Vonarje Dam Modernisation (Hamowa Project Page)

Zaključen projekt obnove pregrade Vonarje

Significance of Hydromorphological and Sediment Analysis in River Basin Water Quality Management