Sediment capture ponds in the Latvian State forests

Year of issue

2025

Summary

During recent years the construction of sediment capture ponds as a part of the drainage system has become a good practice measure in the forests managed by Latvian State Forests. Therefore, some of the environmental impacts of this measure have been monitored to justify its costs. The results indicate differences between monitoring sites set up on mineral or peatland soils as well as between different measured parameters. Additionally, it seems that the effectiveness of the measure depends on the skills and quality of the work carried out by professionals constructing the ponds.

Since 2012, several studies led by the Latvian State Forest Research Institute "Silava" have evaluated the water quality outcomes at multiple sites. Results show that sediment capture ponds are generally more effective at reducing total suspended solids (TSS) than at retaining nutrients such as nitrogen or phosphorus. Performance varies between sites and years, but TSS reductions of over 60% have been recorded in some cases. However, nutrient retention has been inconsistent and often negligible.

Recent demonstrations under the LIFE GoodWater IP project have tested alternative designs, including ponds with woodchip filters or peak flow control features. These trials further confirmed that pond shape, design, and local hydrological conditions greatly influence performance. Overall, sediment ponds remain a key component of water protection in Latvian forest drainage systems, but may need to be complemented with additional structures or adapted designs to maximise effectiveness.

Photo Gallery







Location

56.5646, 24.618

Project

NWRM

National ID

Latvia_02

Sector

Hydromorphology

Implementation status

Ongoing

Contact

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Overview

Location of the project

Various forest sites accross Latvia.

Country

Latvia

NUTS2 Code

Latvija

Sponge measures implemented in the case study

Ponds and scrapes

Peak flow control structures

Involved partners

Authority type	Authority name	Authority role	Comments	Authority responsibility
Other	Latvian State Forests	Other	State owned forest company which all roles	Responsible
Other	Latvian State Forest Research Institute "Silava"	Monitoring	State research institute on forest issues	Supporting

Site Information

Climate Zone

Cool temperate moist

Temperature (°C)

7.00 °C

Elevation range

Depends on the site

WFD Ecological status

Moderate

WFD Chemical status

Failing to achieve good

Design and Implementation

Project scale

Micro

Project scale specifications

The project involves sedimentation ponds installed at specific forest drainage sites managed by Latvia’s State Forests. Each intervention targets a defined catchment or ditch segment (typically <500 ha), with localised monitoring and site-specific construction.

Project area

272

Design capacity

50

Principles

Low-cost integration with existing forest management

Constraints

Functioning of sediment capture ponds depends on the skill of the professionals who construct it.

Financing

Costs investment information

The sediment capture ponds are built when the drainage systems are renovated, therefore the direct costs related to sediment ponds are unknown.

Costs operation maintenance information

the ponds shall be cleaned annually

Administrative annual cost information

The monitoring of effectiveness of the measure has been carried out as a research project.

Financing authorities

Authority name	Type of funding	Comments
Latvian State Forests	National funds	The measure is a part of renovation and maintenance activities of the drainage system.
European Union	EU-funds: LIFE+	—

Compensations

No

Policy and Governance

Policy description

to prevent erosion and nutrient leackage by reducing stream velocity

Land ownership

State-owned land

Policy targets

Pollutants Removal

Erosion Control

Policy impact

Directive
WFD identified pressure

Part of a wider plan

No

Public consultation

No

Has contractual arrangements

No

Impacts and Monitoring

Monitoring System

Monitoring requirements

Since 2020, monitoring has also been integrated into the LIFE GoodWater IP project, coordinated by the Latvian Environment, Geology and Meteorology Centre (LVĢMC).

Monitoring parameters

Total Suspended Solids (TSS)
Dissolved Organic Carbon (DOC)
Total Nitrogen (Ntot), Nitrate (N-NO_3^-), Ammonium (N-NH_4^+)
Phosphate (P-PO_4^{3-})
pH, flow velocity, water volume, ditch profiles
In some sites: biogenic element export per hectare

Upstream station

samples were take before the sedimentation pond

Downstream station

samples wer taken after the sedimentation pond

Maintenance

Maintenance requirements

Maintenance is carried out by Latvia’s State Forests and includes sediment removal, vegetation control, and structural upkeep. It is done as needed, often following drainage system maintenance.

Impact Assessment Methodology

Performance impact assessment method

Catchment outlet

Performance impact estimation information

assessment of water quality

Socio-economic Impacts

Benefits and co-benefits

By reducing sediment export, ponds help comply with water protection requirements, enabling continued forest operations in sensitive wetland or peatland areas. This supports long-term forest productivity, which is economically important in Latvia (464,000+ ha of drained state forests).

Biophysical impacts: Hydrology

Information on retained water

Water retention: Ponds temporarily retain water from forest drainage ditches, but no quantified data on storage volume or peak flow buffering is provided in current studies.

Information on peak flow reduction

Peak flow control: Some recent designs (e.g. PFC structures) under LIFE GoodWater IP aim to delay outflow during high runoff events, with preliminary success—but no flood control metrics are reported.

Biophysical impacts: Biodiversity

Improved biodiversity

No

Information on improved biodiversity

Ponds likely create small aquatic habitats in drained forest landscapes, which may support macroinvertebrates or amphibians, though this remains unverified.

Biophysical impacts: Water & Soil Quality

Water quality overall improvements

Neutral impact-no change in WQ status

Information on water quality overall

The monitoring results of 2012/2013 differ among sites, and also among chemical elements. Nutrient concentrations remained generally low but retention was not statistically significant across all sites. No clear retention; in some years, DOC concentrations increased after the pond (e.g., BU1 in 2013: 35.7 mg/L before pond vs. 35.1 mg/L after).

Information on water quality improvements (P)

The change in P-PO4 (3+) concentrations is different between the sites - some locations show increase, some decreased and in some no change between inlet and outlet of the sedimentation pond.

Information on water quality Improvements (N)

The change in total N concentrations is different between the sites - some locations show increase, some decreased when the concentrations between inlet and outlet of the sedimentation pond.

Information on water quality improvements (TSS)

The change in TSS is different between the sites - some locations show increase, some decreased when the consentrations between inlet and outlet of the sedimentation pond. E.g., up to 62–70% reduction in TSS in standard ponds and PFC structures. TSS levels in sites like ST2 dropped from 43 mg/L to <5 mg/L over time.

Soil quality overall improvements

Neutral impact-no change in SQ status

Biophysical impacts: Others

Ecosystem impact climate regulation

No specific impact

Lessons Learned

Key lessons

The measures to build sedimentation ponds in forest drainage systems have been implemented in Latvia; however their impact on the water quality has not been evaluated. The case study presents the research results of monitoring of impact on water quality due to installation of the sedimentation pond. The results indicate that the values differ between the years of installement. It is importan that the ponds are installed that the river water can not be flow into the draianage system as well the ponds should be cleaned annually.

Design matters for effectiveness : Pond shape, size, and construction quality strongly influence sediment retention. Poorly designed or undersized ponds show limited impact. Ponds built to a standard size (~3 m²/ha or more) tend to perform better.

Good for sediments, weak for nutrients : Ponds are effective at reducing total suspended solids (TSS), with reductions up to 70% in some sites. However, they are not reliably effective for retaining nitrogen, phosphorus, or DOC.

Site conditions drive performance : Results vary significantly by soil type (mineral vs peat), hydrology, and sediment load. Maintenance activities (e.g. prolonged ditch works) can temporarily reduce pond effectiveness.

Integration into routine forest management is key : Incorporating ponds into regular drainage maintenance makes implementation cost-effective and logistically feasible.

Complementary measures may be needed : For improved nutrient retention or hydrologic regulation, additional structures (e.g. Peak Flow Control, woodchip filters) may be necessary.

Monitoring is essential : Regular sampling before/after ponds provides insight into their actual function and guides design improvements. Long-term monitoring helps account for seasonal and annual variability.

Barriers

Barrier type	Barrier role	Comments
Expected maintenance needs	Main barrier	The sediment capture ponds should be cleaned annualy
Other	Main barrier	The existing monitoring results does not demonstrate clear effectiveness of the measure as it is implemented at the moment

Drivers

Driver type	Driver role	Comments

Organisation committed to it	Main driver	"Latvian State Forests" has introduced this measure as good management practice
Public pressure	Secondary driver	NGOs are concerned about the impact of drainage systems on water and fish resources

Success factors

Success factor type	Comments
Attitude of relevant stakeholders	The sediment capture ponds are promoted by NGOs and some scientific literature, therefore if the monitoring results in upcomong years will be convincing then the measure could be continued.

Transferability

This low-cost, simple measure is highly transferable to other managed forest areas with artificial drainage, especially in boreal and temperate zones. However, its effectiveness depends on site conditions, pond sizing, and construction quality. It works well for sediment retention but is less effective for nutrients. Careful design, professional implementation, and basic monitoring are essential. Combining it with other measures may be needed to meet broader water quality goals.

Sources

Sources

Metodes un tehnoloÄ£ijas meža kapitÄ lvÄ“rtÄ«bas palielinÄ šanai

The efficiency of forest drainage system sedimentation ponds in the context of water quality

Latvijas valsts meži un Silava demonstrē paveikto Toras un Āģes upju baseinos

SOLUTIONS AND EFFECTIVENESS OF WATER PROTECTION STRUCTURES IN FOREST DRAINAGE SYSTEM MAINTENANCE: EXAMPLES FROM LATVIA