BALTFLOODS, Baltic Flood Resilience and Digital Solutions

Deliverable 1.4
Pilot Implementation Plan

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Interreg Baltic Sea Region

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RESPONSIVE PUBLIC SERVICES

BALTFLOODS

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About BALTFLOODS Project

BALTFLOODS aims to enhance flood preparedness and mitigate runoff pollution in cities across the Baltic Sea region by leveraging digital and technological solutions and engaging citizens as key stakeholders. The project addresses three main challenges aligned with the thematic scope of Priority 1 of the Interreg Baltic Sea Region Programme, particularly Objective 1.2. Firstly, BALTFLOODS will improve disaster preparedness and response to floods by implementing advanced monitoring systems that provide real-time data for timely interventions, benefiting local and national public authorities, infrastructure owners, and service providers. Secondly, the project will decrease the discharge of polluted stormwater, thus enhancing environmental quality and public health. This involves monitoring water quality through innovative approaches that support environmental and public health goals. Thirdly, BALTFLOODS will increase community engagement in flood and water pollution issues through participatory tools, empowering citizens and educational institutions to take an active role in environmental stewardship. By fostering a well-informed and proactive community, the project builds societal resilience to environmental threats. Transnational cooperation will be essential to facilitate knowledge exchange, policy alignment, and resource pooling to enhance the scalability and sustainability of the solutions, ultimately benefiting urban populations and the Baltic Sea Region ecosystem.

Learn more about the project:
www.interreg-baltic.eu/project/baltfloods

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Authors	City of Lappeenranta: Sanna Varis Gjøvik municipality: Inger Katharina Gregersen, Trond Hulleberg Lappeenranta-Lahti University of Technology LUT: Liuliu Du-Ikonen Norwegian University of Science and Technology: Steven Yves Le Moan

Executive Summary

The BALTFLOODS pilot implementation plan serves as a structured action plan for implementing and validating innovative digital solutions for stormwater and flood management across municipalities. Developed for Work Package 2, the plan ensures that proposed solutions and methodologies are effectively executed to achieve the project's intended outcomes.

Key components of the plan include a timeline detailing procurement, installation, testing, and evaluation activities. The implementation is designed to be responsive to feedback and changing conditions.

The plan is grounded in a comprehensive needs assessment, incorporating insights from interviews with municipalities, national institutions, and public service providers (Annex A in D1.1). These findings highlight widespread challenges in preparedness, monitoring, and citizen engagement, and underscore the urgent need for integrated data systems and real-time environmental monitoring. Pilot implementation plan translates these needs into four pilot-ready solutions: Stormwater quality monitoring, V-overflow modules with monitoring solution for storm water quantity, Integrated data platform, and Citizen-engagement application. Each pilot follows a structured implementation logic with defined procurement paths and testing protocols, ensuring validation under real Nordic conditions. The plan's API-first architecture supports adaptability across diverse municipal contexts.

Sustainability and risk management are embedded throughout the workflow. Data-quality standards, indicator sets and the Sustainability Rating Method guide daily operations, while robust mitigation strategies address technical, organizational, and environmental risks. A strong participatory approach, including co-design workshops, citizen science activities and open-access tools promote citizens as active contributors, enhancing data richness and fostering long-term community ownership.

Finally, harmonised workflows, standardized data structures and shared evaluation criteria support cross-border collaboration and performance comparison. This enables the development of a replicable implementation model that other cities in the Baltic Sea Region—and beyond—can use to improve stormwater management resilience.

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Table of Acronyms

Acronym	Full Term	Description
API	Application Programming Interfaces	A set of protocols that enable different software components to communicate and transfer data
CMS	Content Management System	A software that empowers users to create, manage, and modify digital content without coding expertise
CSO	Combined Sewer Overflow	Discharge of untreated wastewater, mixed with stormwater and other runoff, into waterways from a combined sewer system
D1.3/ D3.1/ D3.5	Deliverable Numbers	Internal project numbering for deliverables
HT	Handprint Thinking	An approach focuses on measuring and promoting the positive impacts of a product or service
LCT	Life Cycle Thinking	An approach evaluates the environmental, social, and economic impacts of a product or service throughout its entire life cycle
LiDAR	Light Detection and Ranging	A remote sensing technology that uses pulsed laser light to measure distances to objects and create precise 3D models of the environment
NBS	Nature-Based Solution	Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience
NGOs	Non-governmental organisations	Civil society organisations
RA	Risk Assessment	A systematic process for identifying potential hazards, evaluating their likelihood and severity, and determining appropriate measures to eliminate or control these risks
SDGs	Sustainable Development Goals	17 universal goals adopted by all United Nations Member, forming the 2030 Agenda for Sustainable Development.
SRM	Sustainability Rating Method	A method providing a comprehensive framework designed to assess and enhance sustainability performance of solutions.
UI	User Interface	The point of human-computer interaction and communication on a device, webpage, or ap
WP2/WP3	Work Package	Internal project structure naming

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Introduction

The increasing precipitation and intensity of rainfall events driven by climate change, combined with the growing proportion of impervious surfaces in urban areas, pose significant challenges for stormwater management in cities. Regardless of their geographical locations and local conditions, both pilot municipalities, Lappeenranta in Finland and Gjøvik in Norway, face similar issues related to rising risks of urban flooding, sewer system overflows, and the management of stormwater quality. Stormwater refers to rainwater and snowmelt, and overflow means discharge of untreated urban wastewater into receiving waters from combined sewers (Directive (EU) 2024/3019).

Particularly in densely built-up urban areas measures are needed to improve stormwater management and strengthen the resilience of communities. To respond to these challenges, four pilots will be implemented in BALTFLOODS project. This pilot implementation plan will outline the steps needed to implement and operate the proposed solutions. The plan will be used in WP2 to ensure that the proposed solutions are effectively implemented and that the project reaches its desired outputs.

Particularly in densely built-up urban areas measures are needed to improve stormwater management and strengthen the resilience of communities.

The key content for the implementation plan includes a timeline with activities. The timeline outlines the specific tasks and milestones needed to successfully implement the proposed solutions, including procurement, installation, testing and evaluation. The timeline also includes windows for adjusting the solutions underway, allowing the project team to adapt to changing circumstances and incorporate feedback from stakeholders.

The pilot implementation has been prepared taking into account the needs of the pilot municipalities and the results of the interviews carried out with associated partners (Report on findings from interviews, Annex A in D1.1). The interview findings underscore a shared recognition among municipalities, national public institutions, and utility service providers that current stormwater and flood management systems face serious limitations in preparedness, monitoring, and citizen interaction. While technical capabilities vary significantly across stakeholders, from advanced digital tools in urban centres to the absence of any monitoring in smaller municipalities, all actors articulated a strong need for improved data integration, real-time environmental monitoring, and structured citizen engagement mechanisms, which all will be piloted in BALTFLOODS.

1. Objectives and Expected Outcomes

1.1 Objectives

This implementation plan serves as a practical roadmap for linking preparatory work to real-world piloting, evaluation, and transfer activities across work packages (WP). It ensures that the solutions are ready for operational deployment (WP2) and positioned for adaptation and scaling (WP3). The key objectives include:

- **Turn technical concepts into concrete pilot actions** by outlining the necessary steps for deployment, including stakeholder engagement and local adaptation.
- **Ensure early integration of evaluation logic**, building on experience and lessons from on-going EU-funded projects, to prepare pilots for monitoring from the outset.
- **Strengthen the sustainability basis of implementation**, by structuring indicators and procedures that directly support Deliverable 2.4 (Sustainability Handbook).
- **Prepare for data-informed adjustments**, by embedding mechanisms to evaluate technical feasibility, citizen participation, and pilot performance in real time.
- **Contribute to replicability and scalability**, by producing transferable documentation and templates that ensure other municipalities can adopt the same implementation logic.

The plan is directly supported by Deliverables D1.1 (Framework for piloting and evaluating), D1.2 (Data systems integration plan), and D1.3 (Citizen engagement strategy), which provide the contextual, technical, and participatory foundations for the implementation steps outlined here.

1.2 Expected Outcomes

The implementation plan is expected to produce practical, actionable outcomes that directly support the piloting phase in WP2. These outcomes are intended to ensure readiness for deployment, enable smooth coordination among involved partners, and support future transferability. The main expected outcomes include:

- **Detailed implementation roadmaps** for each of the four pilot solutions, including planning, procurement, installation, testing, and expansion phases—providing replicable timelines and task structures for other municipalities.
- **Technical integration procedures** outlining how sensors, data platforms, and citizen applications were connected to existing municipal systems, including guidance on APIs, connectivity planning, and data flow configuration.
- **Documented testing and evaluation processes** for assessing solution functionality, usability, environmental performance, and data reliability under real-world conditions.
- **Operational insights and adaptive management practices** based on feedback loops and iterative adjustments made during piloting—demonstrating how local authorities use monitoring data to improve implementation in real time.
- **Transfer-ready documentation and use cases** that contribute directly to Deliverables 3.1 (Sustainability Plan for Transfer of Solutions to Target Groups) and Deliverable D3.2 (Best Practice Handbook), showcasing practical examples, validated solutions, and lessons learned from Lappeenranta and Gjøvik.

2. Overview of Proposed Solutions

The city of Lappeenranta and Gjøvik municipality will conduct pilots and will implement the proposed solutions in a real-world environment. The pilot municipalities are also infrastructure owners and public service providers. Other municipalities can adopt these solutions by following the examples and using the documentation produced during the project.

All methods and approaches related to monitoring systems, integrated data platforms and citizen application will be made openly accessible to any municipality—whether part of the consortium or not—for integration into their current data systems. These methodologies will help municipalities interpret the data they collect, ensure consistency in information, and support informed decision-making in climate adaptation and urban resilience planning.

2.1. Summary of Pilots

In BALTFLOODS project, four pilots will be implemented as part of the activities in Work Package 2:

Pilot 1: **Monitoring water quality**, in Gjøvik (NO) and Lappeenranta (FI)

Pilot 2: **V-overflow modules with monitoring solution for storm water quantity**, in Gjøvik (NO)

Pilot 3: **Data management and analysis platform**, in Lappeenranta (FI)

Pilot 4: **Citizen application**, in Lappeenranta (FI)

Pilots 1 and 2 lead to the development of **Output 2.1 Operational monitoring solutions,** which brings together a range of solutions for monitoring pollutants in stormwater.

Pilot 3 is a part of developing **Output 2.3 Integrated data platform for monitoring**, which will serve as a centralized hub for collecting, analysing and disseminating data from different monitoring sources.

Pilot 4 serves as a contribution to **Output 2.2 Application for citizen engagement**. During the pilot, various aspects of citizen engagement will be explored to ensure broad citizen participation and acceptance of the application.

Pilots will be evaluated as described in chapter 4.3 Monitoring and Evaluation Approach. Indicators for each pilot (Table 3) have been pre-identified, though they are not tied to specific targets. The data collected may include both baseline and non-baseline information. The indicator list will be updated based on baseline data and insights gathered through ongoing monitoring activities.

Learnings from all pilots will be included in Deliverable 3.2 Transfer Sessions and Best Practice Handbook. The Handbook will include case studies, data, description of the solutions and their implementation, as well as evaluation results from the pilot municipalities, providing practical step-by-step guidance for municipalities to adopt similar solutions and overcome common challenges.

2.1.1 Pilot 1: Monitoring water quality

The objective of Pilot 1 is to test and evaluate monitoring solutions to assess the quality of stormwater, e.g. micro plastics, metals and organic compounds, and expand continuous monitoring capabilities. The pilot will be carried out in the city of Lappeenranta, Finland and the municipality of Gjøvik, Norway. Their local expertise on the conditions, challenges and practical implementation will be leveraged to refine and tailor the solutions to their specific needs.

Monitoring pollution discharges in stormwater in urban areas is crucial to ensure compliance with EU directives and a safe environment. Comparison with existing run-off water quality models will be carried out using monitoring results. In the city of Lappeenranta, monitoring and reporting on the performance of nature-based solutions for urban stormwater management will be done to develop a better understanding of their impact and to identify priority areas for implementing new NBS.

In addition to stormwater quality monitoring, water levels will be monitored in networks and locations where there is a potential risk of flooding. Such sites may include water bodies or underpasses. Together with monitoring, evaluation of the capacity of stormwater management systems, including drainage system, is important for improving urban flood forecasting and early warning system, as highlighted by respondents in interviews (see Annex A in deliverable 1.1).

Various monitoring solutions, satellite, aerial, and ground-based remote sensing techniques for water quality monitoring will be tested to ensure their suitability for local conditions, their ability to detect pollutants and water levels as well as their performance in the northern conditions

This pilot will expand the coverage and detail of continuous monitoring. Based on the results of the testing, more solutions will be implemented in various catchment areas to build examples of easily implementable monitoring solutions.

In both Pilot 1 and Pilot 2 new monitoring solutions will be integrated to the existing data systems through implementing Application Programming Interfaces (API). Feedback on the piloted solutions will be continuously collected during the piloting process and will be used to validate the solutions created and, if necessary, to adapt them before transfer activities.

2.1.2 Pilot 2: V-overflow modules with monitoring solution for storm water quantity

V-overflow modules enable the easy and dig-free reconstruction of existing underground overflow infrastructure in the stormwater pipe network. V-overflows allow the municipality to monitor and calculate the quantity of stormwater and to manage overflows effectively. Accurate data on stormwater quantity will be essential for designing and operating infrastructure that can handle peak flows without causing overflows, which can lead to environmental pollution and damage to property. The installation of 10 modules is planned in this pilot, generating enough data points to support evaluation of their effectiveness and suitability for the purpose.

Methods will be used to integrate satellite-based radar or aerial LiDAR data with ground-based sensor measurements to monitor and quantify stormwater flows and potential overflow events. Data will be used to optimize the best placement of V-overflows.

2.1.3 Pilot 3: Data management and analysis platform

As the volume of data generated by various sources continues to grow, it is important to have data systems that can store, manage, process and present large amounts of data efficiently. In this pilot a data management and analysis platform will be developed and tested to handle growing data sets.

The work will focus on two main areas. Firstly, analysing the data into information that carries practical understanding about the quantity and quality of the monitored stormwater and other environmental phenomena. Secondly the analysed information will be made available through clear and easy-to-understand User Interface to the local public authorities (primary target group) and other stakeholders. Information will also be made available to the citizens through the APIs.

2.1.4 Pilot 4: Citizen application

In BALTFLOODS, citizen engagement will be utilized to involve local communities in environmental monitoring, urban flood preparedness and increasing community resilience, particularly through the development and use of digital platforms such as the Citizen Application (D1.3). Citizen application is developed to aim for mutual data and information exchange between the citizens and the municipality. As part of the development of the application, functionalities for co-design and crowdsourcing will be developed, and the visibility of environmental monitoring will be improved. Alert system will be created by identifying environmental changes that activate alerts, such as flooding or air quality changes. Citizen science will be integrated to application to help raise awareness about environmental issues and to engage citizens in environmental monitoring. As part of citizen engagement, this pilot includes a series of webinars, expert panels and events to share knowledge about flood preparedness, urban stormwater management and adaptation to climate change with local citizens and other stakeholders.

3. Implementation Plans

The implementation plans outline the specific tasks and milestones needed to successfully implement the proposed solutions, including procurement, installation, testing, and evaluation. The timeline will also include windows for adjusting the solutions underway, allowing to adapt to changing circumstances and incorporate feedback from stakeholders. Timeline and milestones for each pilot are presented in **Annex A**.

3.1 Pilot 1: Monitoring water quality

Pilot 1 can be divided into 4 stages: Planning & Preparation, Solution Procurement including Implementation & Integration, Testing with Data Collection & Evaluation, and Expansion, where the solutions selected through testing are installed in larger scale. Analysis and presentation of the data gathered in Pilot 1 are considered as part of Pilot 3 Data management and analysis platform. The testing stage will determine which monitoring solutions will be installed and used on a larger scale.

Solutions planned to be piloted include cameras, sensors and the digital tools developed in D1.1, e.g. satellite, aerial, and ground-based remote sensing techniques for water quality. High-resolution water quality maps and spatial data products derived from remote sensing data, showing parameters like turbidity, chlorophyll, and potential pollutants (e.g., microplastics, heavy metals, organic compounds).

Planning & Preparation (Month 1–3)

The first stage of the pilot is planning and preparation, which establishes the foundation for the pilot by defining objectives, identifying pollutants and selecting suitable monitoring solutions as well as locations for monitoring.

The identification of key pollutants has been based on the needs identified by the pilot municipalities, compliance with EU directives and target group interviews conducted in WP1. Regarding stormwater quality, the following parameters are considered relevant for monitoring:

- Conductivity
- Turbidity
- pH
- Nitrate and phosphate concentrations
- Total nitrogen (N)
- Total organic carbon (TOC)
- Total solids (TS)
- Total phosphorus (P)
- Heavy metals (e.g. copper, zinc, vanadium, antimony from road runoff)

Selecting relevant pilot areas: In Lappeenranta pilot areas are selected based on a previous project (‘Kaupunkivedet hallintaan Lappeenrannassa’) modelling the areas with the lowest stormwater quality, based on land use patterns and receiving water body characteristics. The pilot areas have been selected to address areas where previous project results show problems with stormwater quality and areas known to be at high risk of urban flooding. In general, areas at risk in terms of both quality and quantity include densely built-up areas with high levels of impervious surfaces, areas with high traffic volumes and areas where the receiving water body is particularly sensitive to stormwater pollutants.

The pilot areas in Gjøvik are based on data mapped during the TransformAr project and data from the municipality's operational control system. This includes the master plan for water and wastewater, covering the period from 2020 to 2032 and the regional plan for water management with its associated action programme for the Glomma water region.

We are using data from overflow points and pumping stations to determine the location of the V-overflows for the stormwater system and the two sets of sensors to measure water quality.

During heavy rainfall, we experience problems with large amounts of stormwater runoff, with some pollution from impervious surfaces such as roads and parking lots. There may also be wastewater entering the stormwater system during heavy rain, when the sewer network receives too much surface water into the pipes. We will use the following procedure to find the location and type of sensors.

After selecting the parameters as well as monitoring areas and needed monitoring solutions, market research will be conducted to browse for monitoring technologies suitable for target pollutants and local conditions and governance.

Solution Procurement, Implementation and Integration (Month 4–9)

In second stage, a range of solutions will be procured and installed to start real-world testing.

Based on the research in stage 1, purchasing different sensors and monitoring solutions that can detect the identified pollutants. Creating guidelines for sensor placement and calibration: Some conditions may apply to the installation of the sensors, for example the sensors must always be below the water surface, which must be considered when choosing the location.

Data connectivity and power supply must be planned and ensured. Data communication will be chosen according to data amounts and battery availability. Monitoring solutions will be integrated with existing data platforms as described in D1.2. Calibration of the equipment is planned to be performed by manual sampling during this stage.

Testing, Data Collection & Evaluation (Month 4-15)

After implementing the first set of solutions, their performance will be evaluated under real environmental conditions. Pollutant levels, sensor uptime and data transmission quality will be tracked. Data on pollutant levels and sensor reliability will be collected and analysed to assess solution effectiveness. Special attention will be paid to the performance of solutions in varying conditions and during winter. Sensors must not

be sensitive to freezing. On the other hand, stormwater drains are not normally filled with water except during rainfall, therefore the sensors must also be able to withstand intermittent drying. The results are analysed to determine the most effective and scalable solutions.

Expansion (Month 13-36)

Implementation of the selected solutions in additional catchment areas to broaden monitoring coverage. The implementation process will be documented for replication (D3.2 Transfer Sessions and Best Practice Handbook). Final documentation will be completed with recommendations for full deployment of the solutions as well as results, lessons learned and recommendations. The performance of the monitoring solutions will be monitored throughout the pilot period, and based on the performance analysis and feedback, adjustments will be made as necessary, for example to the location of the solutions.

Once validated, the solutions will serve as a reliable model for other municipalities, reducing the need for testing and speeding up implementation.

3.2 Pilot 2: V-overflow modules with monitoring solution for storm water quantity

Pilot 2 will develop, procure and install 10 modular V-overflows with integrated radar sensors. This will allow the municipality to measure the flow rates and volumes of stormwater in sewer systems, particularly during and after rainfall events. V-overflows allow the municipality to monitor and calculate the quantity of stormwater and to manage overflows effectively.

Data from the integrated radar sensors will be used together with remote sensing imagery to get accurate data on stormwater quantity. This will be essential for designing and operating infrastructure that can handle peak flows without causing overflows, which can lead to environmental pollution and damage to property.

Planned solutions to be piloted:

Installation of V-overflow in CSO (Combined Sewer Overflow) monitoring equipment.

Testing to evaluate functionality.

Piloting overflow monitoring for volume and frequency.

Time series data and visualizations showing overflow volumes over time and identifying potential pollution points.

Planning and Preparation (Months 1–5)

In the first few months of the pilot, we start the planning and preparation for procurement and installation of the V-overflows.

Locations for the V-overflows are determined by analysing data from overflow points and pumping stations.

Interviews have been conducted with companies and other municipalities. The answers will be analysed and used in the preparation and installation of V-overflows and the monitoring.

Procurement and Installation (Months 3–10)

The V-overflows modules will be installed and developed together with the subcontractor, Xepto. Based on the preparation in stage 1 different local and remote sensing will be installed and planned to use for visualising operational response and infrastructure planning. Guidelines for installing the equipment will be drawn up.

Data connectivity and power supply have to be planned and ensured.

Testing, Data Collection, and Evaluation (Months 11–18)

The performance of the solutions will be evaluated under real environmental conditions. The V-overflows will be monitored in CSOs in relation to rainfall to assess functionality and data quality. The equipment must withstand both freezing conditions and dry periods.

Data will be analysed to assess effectiveness and scalability.

Expansion and Scaling (Months 19–31)

Feedback and results from the testing phase will be implemented into use.

3.3 Pilot 3: Data management and analysis platform

In Pilot 3 it is assumed that data sources have already been integrated into the data management and analysis platform. This has been done in previous projects and as part of Pilot 1 and Pilot 2 of this project.

Planning (Month 1-5)

Specifying how different data types will be stored, including how long data and analyzed data will be saved and who is responsible for it. Additionally, outlining methods for compressing and structuring the data in a more granular form, ensuring that no essential information is lost in the process. (see D1.2).

Defining what new insights are aimed to gain by analyzing or classifying measurement data. Planning how the data will be turned into useful information and outlining the necessary work processes and roles for developing the required algorithms. Finally, we'll agree on how these solutions will be integrated into the existing monitoring platform.

Planning how and in what format information is presented to users so that it is understandable and useful to different users. This can include for example time-series data and visualizations illustrating changes in water quality over time and identifying potential pollution hotspots.

Defining what information will be shared with external users and to what level of detail, and the different groups of users the information is expected to reach. The specific considerations are ownership, licensing and commercial value of the data.

Implementation including procurement (Month 5-20)

Implementing defined data and information storage policies into an existing information system.

Developing and implementing algorithms and classifications into an existing information system.

Implementing the defined presentation methods into an existing information system, for example, high-resolution water quality maps and spatial data products can be derived from remote sensing data, showing parameters like turbidity, chlorophyll, and potential pollutants (e.g., microplastics, heavy metals, organic compounds).

Establishing interfaces (APIs) from the information system to stakeholders. Implementation will take into account defined access rights and data ownership.

The implementation may include procurements, such as API establishing, if they have not already been carried out as part of other activities, or if the organization lacks the resources to complete them independently.

Testing (Month 5-20)

Development of the entire Data management and analysis platform will be performed iteratively (lean development), thus new features are introduced to the system gradually and at each step the users are involved in the work and their feedback is taken into account before the next update. Access to the Data management and analysis platform will be granted to the interested associated partners and they can purchase for their own use sensor types that have already been integrated and monitor their own storm and flood waters during the testing. Thus feedback and user experiences can be collected from them also.

An interview will be conducted to the city employees of Lappeenranta and Gjøvik as well as those associated partners' employees that have used the system during the project to validate and give proof about the systems' usefulness. With the interview we will confirm that expected benefits were reached and collect information if other possible benefits have emerged during or after the introduction of the service. Results of these interviews will be disseminated in the Best Practise Handbook.

Expansion (Month 13-36)

Feedback and results from the testing phase will be implemented into use.

3.4 Pilot 4: Citizen application

In Pilot 4, Citizen Application is developed to involve local communities in environmental monitoring and urban flood preparedness. Application development includes e.g. creating functionalities for co-designing public services, crowdsourcing and creating an alert system. Additional to application development, Pilot 4 includes a range of citizen engagement activities, such as raising awareness by organising events and introducing citizen science activities.

The timeline and milestones for Pilot 4 are as follows:

Planning & Stakeholder Engagement (Month 1–8)

Identifying key stakeholders (citizens, schools, NGOs, municipal departments, citizens). Baseline assessment of current climate adaptation efforts and citizen engagement.

Initial workshops to introduce the pilot and gather input.

App development planning: Defining the new features and functionalities of the CitySen.app, with the goal of maximizing community engagement, improving transparency around climate initiatives, and increasing public awareness of both completed actions and upcoming challenges. These features should support two-way communication and data sharing between citizens and local governments. While it's important to include static or periodically updated content (such as "read more" sections), the primary emphasis should be on delivering dynamic, real-time information that users can filter according to their interests and needs.

Defining, together with the water sampling laboratories, the method of how results from water samples analysed in laboratories can be turned into electronic format and further distributed through data systems to municipality employees, and if data ownership and publicity allows further to stakeholders and/or citizens. The expected result is an API based solution or a Web based data input solution, or both.

Crowdsourcing: Identifying which types of climate-related events or data should be collected from citizens and further specifying the user interface through which this input will be submitted to the CitySen.app. Additionally, the process of how this crowdsourced information will be shared and utilized—both within the app and by relevant stakeholders—should be clearly defined.

Alerts: Defining the type of climate alerts to be issued. Defining the thresholds above which an alert is triggered. These alerts may concern, for example, slipperiness, flooding, pollution, air and water quality or extreme cold or heat.

Planning citizen engagement activities: e.g. co-design activities to define the most beneficial placement of the future nature-based solutions, as well as planning events such as webinars and expert panels.

Citizen science: Selecting environmental indicators (e.g., air quality, temperature, flooding). Planning of training materials and data collection tools. Pilot testing of tools and methods together with the local associated partners.

App development/procurement and implementation (Month 5-12)

Implementing the new planned features to the CitySen.app; e.g. the User Interface (UI) changes to accommodate all new content and content types as well as UIs and outbound APIs for laboratory and crowdsourced data.

Creating static or periodically updating content as well as content management systems (CMS) for the content updated, if a suitable system is not already available. Creating the required dynamic content APIs to data source systems (e.g. StreetAI).

Creating needed databases and APIs for both laboratory analysis data and for crowdsourced data to StreetAI, which receives and serves the data from and to CitySen.app.

Implementating the climate related alerts to CitySen.app.

Coordinating with schools and other target groups about citizen science. Selecting, purchasing and distributing relevant equipment.

The implementation may include procurements, such as user interface changes and APIs, if they have not already been carried out as part of other activities, or if the organization lacks the resources to complete them independently.

Testing, data collection and evaluation (Month 8-15)

Testing involves improving the features and functionalities of the application to make it more user-friendly and efficient. It will enhance transparency of environmental monitoring, help citizens identify environmental changes and give out alerts about sudden climate related changes within the living environments. Application is tested as part of environmental education in schools. The application provides the users with an overview of the regional environment, the results of real-time monitoring as well as information on the impacts of climate change and adaptation to climate change.

Local authorities will distribute information (about climate change, results of real-time monitoring etc.) to the citizens and other users. The users will report the issues to the authorities and provide them with the data. Local authorities will utilize the data (water samples, other monitoring results, feedback etc.) in their work. The communications with the citizens through the use of application will enable authorities to:

- involve citizens in the needs assessment and design processes of streets, parks and for example placement of nature-based solutions as well as

- will help the authorities to improve services such as street maintenance, stormwater management and, for example warning systems about interruptions to public services due to flooding.

Expansion/scaling (Month 15-28)

Feedback and results from the testing phase will be implemented into use. Integrating citizen input into climate-resilient public services.

Organizing events/activities (Month 6-36)

Using co-design principles, LUT University integrates an assignment into its Sustainable Cities course, where students develop features for the Citizen Engagement Tool. Using a seven-step Co-Design Path, students identify target groups, explore their needs, and design inclusive, practical solutions for flood preparedness. The activity applies six defined principles of citizen science: simplicity (intuitive tools), accessibility (engaging, motivating features), data validation (peer or authority review), educational integration (linking theory to practice), inclusivity (language and access considerations), and feedback loops (showing how data is used).

Implementation of the planned NBS-related co-design activities: Co-designing activities will be organized to ensure inclusivity and transparency in decision-making processes to address community needs effectively.

Webinars and expert panels will be organized to share knowledge with citizens about flood preparedness, runoff pollution and climate change adaptation. Together with local schools and associated partners, thematic events focused on stormwater management will be organized. The program could be divided into two segments: a daytime session tailored for students and school children, and an evening session designed for the general public, with a particular emphasis on engaging students' parents, relatives and local residents.

Citizen science: Involving schools and citizens in collecting data on stormwater quality, such as water pH, temperature, or pollutant levels. Coordinating with schools and other target groups about citizen science. Visitor lectures will be organized at local schools, guiding the use of equipment and the app and to collect feedback from the teachers and students.

4. Operational Considerations

The subsequent chapters outline the resource requirements, governance, and coordination strategies for each pilot.

4.1 Resource Requirements

Table 1. Required Resources per each pilot.

Resource	Pilot 1 Monitoring water quality	Pilot 2 V-overflow modules	Pilot 3 Data management and analysis platform	Pilot 4 Citizen application
Municipality employees	- Stormwater management responsibles - Procurement experts	- Stormwater management responsibles - Procurement experts	- Data and information users and decision makers	- Stormwater management responsible
Outsourced experts	- Water quality measurement laboratory - System development & project expert	--	- System development & project expert	- Water quality measurement laboratory - System development & project expert
Technology vendors	- Sensor vendors - Datasystem vendor for integration	- V-Overflow vendor - Datasystem vendor for integration	- System development vendor; analysis and API development & implementation	- System development vendor; application, API and database development & implementation
Academic partners	- Digital tools planning experts	--	- Analysis method and algorithm development - Data presentation experts.	- Stakeholder involvement and information gathering experts
Associated partners	- Stormwater management responsibles	- Stormwater management responsibles	- Stormwater data and information users and decision makers	- Pupils capable of performing citizen science
Stakeholders	--	- Water supply management responsibles	- Stormwater data and information users and decision makers	--
Citizens	--	--	--	- Persons capable of performing citizen science, crowdsourcing and co-design.

4.2 Governance and Coordination

Table 2. Governance and coordination for each pilot.

Resource	Pilot 1 Monitoring water quality	Pilot 2 V-overflow modules	Pilot 3 Data management and analysis platform	Pilot 4 Citizen application
Group of activities leader	Norwegian University of Science and Technology (NTNU)	NTNU	NTNU	University of Gothenburg (GU)
Participating project partners	Gjøvik municipality (MOG), City of Lappeenranta (LAPP) GFZ Helmholtz Centre for Geosciences (GFZ) NTNU Lappeenranta-Lahti University of Technology LUT (LUT)	MOG, NTNU, CEEV, GFZ	LAP, NTNU, CEEV, GFZ	LAP, NTNU, CEEV, GFZ

	Carpe Europe e.V. (CEEV)			
Practical pilot implementation done by	City of Lappeenranta Municipality of Gjøvik	Municipality of Gjøvik, Department of Water and Sanitation	City of Lappeenranta, Urban development/Streets and Surroundings	City of Lappeenranta, Urban Development/Streets and Surroundings

4.3. Monitoring and Evaluation Approach

The monitoring and evaluation approach outlined in this section forms the core content of the Sustainability Handbook (Deliverable D2.4). It builds directly on the methodological foundation developed in the TransformAr (Accelerating and upscaling transformational adaptation in Europe: demonstration of water-related innovation packages) project — particularly the Sustainability Rating Method (SRM) — and serves as an introduction of the sustainability-focused work in WP2 and WP3. In BALTFLOODS, this work extends the SRM by embedding it into the operational reality of municipal-level piloting in Lappeenranta (FI) and Gjøvik (NO), while also adapting it to evaluate digital solutions, real-time data platforms, and citizen engagement mechanisms. The outputs of this approach will directly inform D2.4, which functions not only as a sustainability assessment report, but also as a practical reference and transfer tool for use by other cities and regions.

The SRM, originally developed in TransformAr (Deliverables D5.2 and D5.9), provides a structured and transparent framework for assessing environmental, social, and economic performance of climate adaptation solutions. BALTFLOODS adopts the SRM as its core evaluation method and advances it in two key ways:

- by operationalising it within the context of live digital and infrastructure pilots; and
- by integrating participatory data, such as citizen-generated reports, into the sustainability evaluation process.

The monitoring and evaluation approach in BALTFLOODS retains the three foundational pillars of the SRM:

- Environmental performance – including water quality improvement, emission and runoff reduction, and ecosystem impacts;
- Social performance – including citizen engagement, data transparency, and accessibility;
- Economic performance – including cost, cost-efficiency and business model economic risk.

In alignment with SRM, BALTFLOODS applies the principles of:

- Life Cycle Thinking (LCT) – to assess sustainability across the full lifespan of the solutions;
- Handprint Thinking (HT) – to emphasize the proactive, positive contributions to resilience and public value;
- Risk Assessment (RA) – to ensure each pilot accounts for climate, technical, and societal risks and adaptation capacity.

In BALTFLOODS, the Sustainability Handbook is not merely an evaluation tool. It has been conceived as a practical and strategic resource that brings together assessment logic, context-specific indicators, pilot-level findings, and guidance for replication. It captures:

- Real-world evidence from the pilots;
- Indicators adapted to stakerholds' needs;
- Integration of citizen-generated data into monitoring frameworks;
- Reflections on scaling and long-term sustainability governance.

Each of the four pilot solutions is monitored through tailored indicators, derived from the SRM and refined for BALTFLOODS' specific operational context (Table 3).

Table 3. Pilot-Specific Monitoring

Pilot	Selected Performance Categories	Example Indicators*
Water Quality Monitoring (Pilot 1)	Pollution detection capability, spatial coverage, system durability	Pollutant concentration, average uptime, data transmission success rate, integration capability, data accuracy, financial viability (investment, maintenance and operation)
V-overflow Modules (Pilot 2)	Overflow control performance, climate resilience, maintenance ease	Reduction in overflow events, module uptime, installation time, data accuracy
Data Management Platform (Pilot 3)	System interoperability, real-time analytics, scalability	API response time, data latency, external integration count, satisfaction score

Citizen Application (Pilot 4)	User engagement, reporting impact, accessibility	Open day held by demonstrator cities, webinar and expert panel, social media posts, best Practice Handbook published

* Example indicators are pre-identified and will be refined during implementation based on real-world conditions, data availability, and stakeholder feedback.

The evaluation follows the SRM's structured steps:

1. **Scoping**: Define local challenges, strategic goals, and baseline;
2. **Implementation**: Select relevant performance categories and indicators;
3. **Data Processing**: Collect, normalize, and score performance data;
4. **Assessment**: Aggregate scores, visualize outcomes, and derive conclusions.

This work will also feed directly into D3.1 – Sustainability Plan for Transfer of Solutions to Target Groups by detailing monitoring solutions and applications for citizen engagement, and into D3.2 – Transfer Sessions and Best Practice Handbook by showcasing the experiences and lessons learned from the pilot municipalities. In addition, it will support capacity-building efforts by offering a tested, context-sensitive methodology and evidence-based results to be shared with other municipalities and regional stakeholders.

5. Transnational Value and Replicability

The BALTFLOODS project has been designed with a clear emphasis on transnational relevance and practical scalability. Beyond the implementation of pilot solutions in Lappeenranta (Finland) and Gjøvik (Norway), Deliverable D1.4 (Pilot Implementation Plan) establishes the foundation for replicable and transferable approaches that can benefit other municipalities across the Baltic Sea Region and Europe. This section outlines the transnational value of the project, the mechanisms through which replicability is ensured, and how this work connects with future deliverables under WP3.

5.1. Harmonized Implementation Logic

One of the key transnational values of BALTFLOODS lies in the development and documentation of a harmonised implementation logic that can be adapted to various local contexts. While the infrastructure, governance models, and environmental challenges may differ between municipalities, the step-by-step methodology applied in this plan ensures consistency in how digital, infrastructural, and participatory solutions are introduced and evaluated.

This plan identifies a structured yet flexible sequence of implementation actions that can be adapted to the needs of cities with differing levels of technical readiness, digital maturity, and citizen engagement. These steps include:

- Defining pilot-specific objectives, scope, and expected outcomes in collaboration with local actors (Section 2);
- Preparing implementation logistics, including procurement, installation, and scheduling (Section 3.1 and 3.2);
- Integrating monitoring technologies and IT infrastructure, including API connections and data flow alignment (Section 2.1.3, 3.3);
- Activating local engagement processes through citizen application piloting, school partnerships, and stakeholder communication (Section 2.1.4, and 3.4);
- Enabling continuous monitoring and adaptation by embedding evaluation tools and feedback mechanisms (Section 3.4 and 4.3).

This shared approach allows cities to apply the same implementation logic and evaluation process while adapting to local capacities and institutional conditions. It also supports comparability between urban contexts, enabling policy benchmarking, shared learning, and regional collaboration around water resilience and flood prevention. Moreover, the involvement of diverse stakeholders in co-designing the pilot solutions ensures that the implementation logic accounts for both technical requirements and socio-cultural factors, enhancing its utility in varied transnational settings. This inclusive approach promotes the broader adoption of the solutions while ensuring their adaptability and acceptance in different governance and societal frameworks.

5.2. Replicable Tools and Indicators

A central pillar of transnational value in BALTFLOODS is the design of tools and implementation practices that can be adapted and adopted in different local contexts. The project focuses on practical interoperability, open access, and documentation that reduces entry barriers for municipalities with varying levels of technical readiness, institutional capacity, and financial resources. Several aspects of the implementation plan support replicability:

- Sensor and Monitoring Solutions: The water quality and stormwater quantity monitoring solutions are based on commercially available hardware and open data standards, facilitating procurement and installation in other cities.
- Citizen Application: The citizen engagement platform is fully open source and built with modular components. This allows for local customization while maintaining core functionalities such as reporting, alerting, and public data access.

- Integrated Data Platform: The cloud-based platform is designed with interoperability in mind, using standard API protocols that can be connected to various legacy systems. This promotes technical integration across different municipal IT environments.
- Performance Indicators: the indicators used for monitoring the pilots can be applied to other cities with minimal adjustment. They align with the Sustainable Development Goals (SDGs) and incorporate both quantitative and qualitative dimensions.

In addition, all tools are accompanied by clear documentation and usage guidelines, as will be consolidated in the Sustainability Handbook (D2.4). This documentation ensures that peer municipalities not only have access to the tools but also understand how to adapt and deploy them.

Importantly, the BALTFLOODS approach also integrates citizen-generated data as part of the monitoring strategy. This innovation increases data availability and fosters community ownership, both of which are critical to the successful replication and long-term sustainability of adaptation measures in new locations.

5.3. Transfer Contribution

The transnational value of the implementation plan extends beyond WP2 implementation by providing essential inputs to WP3 activities focused on knowledge transfer, upscaling, and policy integration.

First, Deliverable D1.4 defines the monitoring and evaluation structure that forms the core of the Sustainability Handbook (D2.4). The outputs from WP2 will be assessed using the indicators and methods detailed in this plan, and the results will be translated into transferable lessons and replicable strategies.

Second, the outputs of D1.4 will feed directly into:

- D3.1 – Sustainability Plan for Transfer of Solutions to Target Groups by detailing monitoring solutions and applications for citizen engagement
- D3.2 – Transfer Sessions and Best Practice Handbook by showcasing the experiences and lessons learned from the pilot municipalities.

Third, the tools and insights developed through BALTFLOODS will be used in stakeholder engagement and capacity-building efforts across the Baltic Sea Region. Workshops, peer exchanges, and practitioner training sessions will use the materials from D1.4 and D2.4 to help other municipalities understand how to apply the solutions locally.

In this way, the implementation plan is not only a local roadmap but also a strategic instrument for regional transformation. Its combination of methodological rigor, operational practicality, and transferability ensures that the impact of BALTFLOODS extends well beyond its initial pilot sites.

Conclusions

Deliverable 1.4 charts a clear, actionable course from concept to field piloting for the BALTFLOODS partnership. Drawing on the needs analysis and stakeholder insights compiled in earlier work packages, it translates four complementary solutions—storm-water quality monitoring, V-overflow modules, an integrated data platform and a citizen-engagement application—into phased programmes with defined timelines, procurement pathways and testing protocols. The staged approach ensures that each tool is validated under real Nordic conditions before wider roll-out, while the common implementation logic and API-first architecture keep the methodology adaptable to diverse municipal contexts.

Sustainability considerations are woven directly into the workflow. Data-quality rules, indicator sets and the Sustainability Rating Method are integrated with day-to-day pilot tasks, so evidence accumulates continuously for later evaluation and transfer activities. Robust risk-management procedures accompany each phase, providing clear mitigation measures for technical, organisational and environmental uncertainties.

By coupling advanced sensing and FIWARE-based data integration with co-design workshops, school programmes and the open-licence CitySen.app, the plan turns citizens from passive recipients of information into active contributors. This participatory dimension deepens community ownership, enriches data streams and supports long-term upkeep. Harmonised workflows, shared data models and joint evaluation metrics unlock cross-border learning and benchmarking, creating a replicable blueprint that cities across the Baltic Sea Region—and beyond—can adopt to strengthen their resilience to storm-water challenges.

Annexes

Annex A. Timeline with milestones

References

Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment (recast) (Text with EEA relevance). Accessed 27 August 2025. Retrieved from https://eur-lex.europa.eu/eli/dir/2024/3019.

Towards flood resilient cities powered by data and people.

LAPPEENRANTA

GJØVIK KOMMUNE

LUT University

NTNU
Norwegian University of Science and Technology

UNIVERSITY OF GOTHENBURG

Cape Europe

GFZ Helmholtz Centre for Geosciences

Interreg
Baltic Sea Region

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Annex A.
Timeline and Milestones